



# The Impact of COVID-19 Pandemic on Economic Convergence Between Developed and Developing Nations

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## ABSTRACT

This study investigates convergence between developed and developing countries' GDP during the pre-COVID-19 era (1960-2019) and post-COVID-19 era (2020-2023) using World Bank data and the Augmented Dickey-Fuller (ADF) test. For the pre-COVID period, results show no significant convergence, with an ADF statistic of  $-1.78$  and a  $P = 0.39$ , likely due to disparities in industrialization and governance. Similarly, post-COVID results (ADF statistic  $-1.2$ ,  $P = 0.67$ ) also suggest no convergence, possibly exacerbated by pandemic-related challenges. The study highlights that structural barriers and the pandemic have hindered economic convergence.

**Keywords:** Convergence Theory, Covid-19 Pandemic, Augmented Dickey-Fuller Test, Developing Countries, Developed Countries

**JEL Classifications:** O47, E32, F43, O57, C22

## 1. INTRODUCTION

This study's objective is to present a particular context within which future development and convergence economic research can be undertaken and comprehended. The debate about the possibility of developing countries reaching similar economic development to today's industrialized or developed countries has become a significant concern. Further, the impact of the covid-19 pandemic has affected the world's financial, technological, infrastructural, and industrial situations. It has been seen that the economic development disparities among countries are becoming widening (Kuznets, 2019). As a result, the article looks at the question of whether the economic convergence theory can still hold. In summarizing the argument, convergence will happen when low-income countries eventually catch up to high-income nations in terms of GDP per capita (Kong et al., 2019). Even if high-income and low-income countries increase investment in physical and human capital to expand GDP, convergence may occur.

According to Dueñez and Iovino (2017), since developing countries typically expand faster than industrialized countries, the convergency theory postulates that all economies would ultimately converge in terms of per capita income. Simply put, economies that are currently less developed will eventually catch up to those that are more developed. This is consistent with the finding that economies in developed nations grow slower but more stable than those in developing countries.

In a publication by United Nations. (n.d.) leading economists warn that COVID-19's effects on developing countries will be severe and long-lasting. The UN high-level advisory group calls for global cooperation to stop the COVID-19 crisis from pushing nations apart, which is not in line with the convergence theory. The covid-19 pandemic has affected countries' GDP per capita, causing many disparities (Deaton, 2021). A study by Abrahám and Vošta (2022) concluded that significant convergence trends have reversed due to the Covid-19 pandemic. A lower decline in GDP in the EU's developed nations has impacted divergence within the bloc.

Similarly, the IMF, World Economic Outlook (October 2022) has forecasted a global decline in economic growth rate from 2022 with 3.2% to 2.7% in 2023. The report gave further details where economic growth projections show a decline for emerging markets and developing economies from 6.6% in 2021 to 3.7% in 2022 and 2023. The emerging markets and developing countries have shown a declining trend during the post-pandemic era, with a rate of -2.9%.

The research gap of this study is based on Brussevich et al. (2022) studies which concluded that in the post-shock recovery era of the covid-19 pandemic, there is documented per-capita income divergence, with the lowest-income countries falling significantly behind. Their paper's outcome affects the long-held growth theory of convergence. Hence, this quantitative research provides empirical evidence.

According to Ruge et al. (2003), the implications of the study of convergence are much more far-reaching than the impact theory has so far mentioned. It has led to the discovery of novel stylized facts concerning cross-country growth regularities, including perseverance and bimodality. These observations are now being put into the growth theory. Furthermore, new methods for quantifying the extent of technological disparities between countries have been developed directly from the attention that convergence research has brought to bear on the topic. These quantitative initiatives yield a new data set to test hypotheses about how to bring innovative technologies to market best. Trade, migration, and the expansion of industries are all areas in which countries interact. The convergence research has yielded significant results and paved the way for promising new avenues of study.

## 2. REVIEW OF LITERATURE

Economic theories evolve alongside the transformations of the global economy. Modern economic growth theory has undergone significant development, shaped by major contributions from scholars like Ramsey (1928), Harrod (1939), Domar (1946), and Solow (1956) and Swan (1956). Notably, the Solow-Swan model sparked a revival in economic growth theory, introducing new approaches and concepts, such as convergence theory. This model is characterized by its assumptions of constant returns to scale, diminishing returns to each input, and a positive, smooth elasticity of substitution between inputs (Barro and Sala-i-Martin, 2004). While the concept of economic convergence initially applied to blocs of similarly developed economies, it has since opened new avenues for studying economic development. It offers insights into potential future growth for developing countries and helps forecast the speed at which they might advance.

During the Industrial Revolution and beyond, the economies that are now considered developed experienced rapid economic growth fueled by ongoing technological advancements, product innovations, and capital accumulation. These changes ushered these nations into the era of mass consumption, leading to a sustained increase in demand and the expansion of infrastructure. European economies, followed by the United States and Japan after World War II, saw substantial growth in national and per

capita income (Kroeber, 2020). This period of rapid development and high economic growth helped propel these countries to their current status. Over nearly five generations, despite interruptions from economic crises, recessions, the 2008 Great Recession, and geopolitical conflicts, these economies have reached a steady state of economic growth. Was this outcome predictable? The structure of many of these economies, especially that of the U.S., reveals a decline in the growth rate of personal consumption expenditure (Guerrieri et al., 2022). The steady-state growth they now experience could be attributed to the full utilization of their productive capacity.

The period of rapid accumulation, where households were eager to maintain high levels of consumption expenditure, appears to have slowed down. Over the past two decades, the marginal propensity to consume has shown a declining trend. While demand for durable goods has risen during this period, its growth rate remains modest. Emmons (2012) notes that consumption has been a primary driver of U.S. economic growth, given the high ratio of personal consumption expenditures (PCE) to GDP. However, the conditions that characterized the five decades leading up to 2010 are shifting. The current rise in demand for durable goods may be attributed to changing tastes and a growing young population establishing new households. Nevertheless, changes in taste may not be a strong enough factor to sustain long-term economic growth, nor can the growing young population in countries with low birth rates fully drive demand. This demand structure in developed economies may act as a drag on growth.

Despite this, it is important to acknowledge that these economies have historically experienced robust economic growth fueled by high consumption, investment, and ongoing technological innovation. However, from the late 1970s through the 2000s, the declining trend in growth rates for key economic indicators supports the hypothesis of a steady growth rate in industrialized economies. In contrast, many developing countries are experiencing high economic growth rates, with some even achieving double-digit growth (Panth, 2021). This divergence in growth rates between developed and developing countries may provide some justification for the convergence process observed in certain developing nations.

### 2.1. Convergence Process and the Long-Run Perspectives for Developing Countries

Researchers typically examine various aspects when discussing convergence between developed and developing countries. For instance, Barro and Sala-i-Martin (1992) identified two key concepts of convergence. The first is  $\beta$ -convergence, which captures the negative relationship between a country's initial level of output (and income) and its subsequent rate of economic growth. In this model, the lower a country's initial level of output and income per capita, the higher its rate of economic growth over time, and vice versa. The second concept is  $\sigma$ -convergence, which refers to the narrowing of income differentials over time, as the real income per capita among countries becomes more equal.

The work of Ramsey (1928), later refined by Solow (1956) and Swan (1956), is often cited as foundational in the development

of convergence theory. Ramsey's (1928) seminal publication, "A Mathematical Theory of Saving," introduced the idea of convergence and a steady economic growth rate while analyzing the role of saving in long-term economic growth. Since then, a large body of literature has expanded upon and developed the concept of convergence.

In their respective works, Solow (1956) in "A Contribution to the Theory of Economic Growth" and Swan (1956) in "Economic Growth and Capital Accumulation" introduced the notion of conditional convergence. They argued that the convergence of economies depends on initial conditions such as population growth, savings rates, and levels of technology. Conditional convergence suggests that each economy will converge toward its own steady-state growth rate based on its unique initial conditions. This stands in contrast to unconditional convergence, which posits that all economies will eventually converge to the same level of economic growth and similar GDP per capita. Unconditional convergence is based on the idea that developing countries, due to their faster growth rates, will eventually catch up to developed countries, closing the income gap over time.

The convergence process can be explained by the fact that as countries approach or achieve full employment of their factors of production, households also move toward or reach their full potential for consuming durable goods. As a result, the dynamism of the economy slows down, leading to slower economic growth. Ramsey (1928) highlighted this idea, noting that in a steady state, where the optimal level of the capital stock has been achieved, in the absence of technological or population growth, capital and consumption remain constant, and consequently, saving equals zero.

It is also important to emphasize that in developed economies, such as the United States, economic growth rates exceeding 4% which is the full employment growth rate can lead to overheating of the economy and potentially result in an economic crisis (Summers and Domash, 2022). In contrast, double-digit economic growth rates are common in many developing countries. The difference in outcomes from high economic growth is largely due to the degree of utilization of factors of production.

While developed countries are experiencing a steady state of growth, many developing nations are at a takeoff stage, where they are beginning to experience high levels of consumption and increasing investment. These economies are still far from achieving full employment of their factors of production and are not yet maximizing their potential for durable goods consumption. In fact, these countries are in the early stages of mass consumption, which is a key feature of the takeoff stage and plays a crucial role in driving economic growth and development.

In the 1980s, debates surrounding the reality of convergence between countries and the conditions that might favor it were shaped by divergent statistical results. A study conducted by Maddison, which analyzed a sample of sixteen industrialized countries using long-term data from 1870 to 1979, supported the idea of convergence between these nations. This study,

endorsed by Abramovitz (1986) and later revisited by Baumol (1986), reinforced the concept of convergence. However, De Long questioned these conclusions, pointing out that Maddison's sample excluded countries that did not share similar characteristics, particularly the poorest nations. A subsequent study that included these excluded countries found evidence of divergence instead.

This episode lent further support to the concept of conditional convergence, as developed by Barro and Sala-i-Martin (1992). However, this idea had already been suggested by Abramovitz (1986), who noted that certain social capabilities were necessary for countries to benefit from the potential advantages of relative backwardness (Prabirjit, 1992). In other words, countries needed specific societal structures and institutions to capitalize on the opportunities available for catching up.

As a result, Barro (1991), Mankiw et al. (1992), and Sala-i-Martin (1996) challenged the earlier notion of absolute convergence initially proposed by Solow (1956) and Swan (1956). The concept of conditional convergence, previously presented by Romer (1986;1990), Lucas (1988), and Robelo (1991), became more widely accepted. This theory posits those countries with similar conditions—particularly in terms of technological progress and population growth—tend to converge in GDP per capita and standard of living (Prabirjit, 1992).

This approach has become the mainstream view within the neoclassical school regarding the theory of convergence. Sarkar (1992), in his article "Are the Poor Countries Coming Closer to the Rich?," argued, "The conditional convergence hypothesis is therefore tautological," asserting that the debate over whether conditional convergence exists is futile. He further emphasized that it would be "ridiculous" to claim that countries like Ethiopia and Mali could catch up to the standard of living in the United States within 35 years. Sarkar's skepticism is grounded in the understanding that several key factors—such as technological innovation, population growth rates, good governance, and property rights—have driven the economic growth of the United States and other developed nations.

However, Sarkar's statement may seem overly strong when considering other research findings. Alternative methodologies have questioned the conditional convergence hypothesis. For instance, Chander Kant (2019) studied 28 countries in Sub-Saharan Africa and South Asia and found that the hypothesis of absolute convergence does not hold. Instead, the notion of relative convergence emerged, where poorer countries grow faster but are not necessarily catching up to the rich at the same pace. As Pfitzner and Lang (2014) noted, the absence of absolute convergence among large samples of nations is possible because dissimilar nations were converging on different steady states. This implies that with diverse experiences and economic conditions, the possibility of long-term absolute convergence is unlikely without similar underlying conditions.

Research on convergence has focused on various groups and regions, with mixed results. Studies have examined convergence among groups of countries (Barro, 2015; Ho, 2006), among

regions (Peron and Rey, 2012), or between states within the same country, such as the work of Barro and Sala-i-Martin (1992) on the United States and Cermeno (2001) on the State of Mexico. These studies further underscore the complexity and variability of convergence, suggesting that while some regions or countries may exhibit convergence tendencies, absolute convergence is far from a universal phenomenon.

However, as mentioned above, new methods have questioned the conditional hypothesis and asserted the possibility of convergence of developing countries toward developed countries. This conclusion is uplifting and develops the idea that developing countries are not caught in the underdevelopment trap and can get out of it. Today's developed economies have not always enjoyed a high level of development. There were indeed preconditions that favored the accumulation of capital that led to the increase in national income over time. It is argued that developing countries do not enjoy the same conditions today; however, they can take advantage of otherwise more favorable conditions, such as the development of means of transport and communication, the results of research and development for which they have not invested, the financial means available through bilateral loans, and from international financial institutions. Likewise, they can build a strong human capital stock by taking advantage of the well-developed education system all over the globe. The returns on higher education should be higher for these countries, as well as the return on research and development, as their investments in these domains are close negligible due to the globalization of resources, including knowledge.

### 3. METHODOLOGY

This study examines the existence of convergence between developed and developing countries by analyzing constant GDP, covering the years 1960-2019 as the pre-COVID-19 era and 2020 to 2023 as the post-COVID-19 era as shown in Figure 1. The data used in this analysis are GDP sourced from the World Bank Data series (World Bank Group, 2024). To test for convergence, the study adopts the Augmented Dickey-Fuller (ADF) test.

The ADF test is an extended version of the standard Dickey-Fuller test, which is used to determine whether a time series contains a unit root, indicating non-stationarity. While the basic Dickey-Fuller test can identify a unit root, it assumes uncorrelated error terms. Paparoditis and Politis (2016) postulate that the ADF test improves on this by incorporating lagged differences of the time series, accounting for potential autocorrelation (correlated error terms), making the test more robust for real-world data. By utilizing the ADF test, this study provides a more accurate assessment of whether the GDP time series for developed and developing countries is stationary or non-stationary, a key factor in understanding economic convergence trends over time.

Research Question and Hypotheses:

- Research Question: Does the time series exhibit a unit root (i.e., is it non-stationary)? Or is there significant evidence of GDP convergence between developed and developing countries during the periods 1960-2019 and 2020-2023?

- Null Hypothesis ( $H_0$ ): The time series exhibits a unit root (i.e., it is non-stationary), or there is no significant evidence of GDP convergence between developed and developing countries during the periods 1960-2019 and 2020-2023.
- Alternative Hypothesis ( $H_1$ ): The time series is stationary, or there is significant evidence of GDP convergence between developed and developing countries during the periods 1960-2019 and 2020-2023.

The general form of the ADF test equation is:

$$\Delta y_t = \alpha + \beta t + \gamma y_{t-1} + \sum_{i=1}^p \delta_i \Delta y_{t-i} + \varepsilon_t$$

Where:

- $\Delta y_t$  is the first difference of the series at time  $t$  (i.e.,  $y_t - y_{t-1}$ )
- $\alpha$  is a constant (drift term)
- $\beta t$  is the coefficient on a time trend  $t$  (optional)
- $\gamma y_{t-1}$  is the coefficient on the lagged value of the series to test for a unit root
- $\sum_{i=1}^p \delta_i \Delta y_{t-i}$  represents the sum of the lagged difference of the series to account for autocorrelation
- $\varepsilon_t$  is the white noise error term.

In simpler terms, the ADF test looks at whether the coefficient  $\gamma$  (on  $y_{t-1}$ ) is significantly different from zero. If it is, the series is considered stationary. If not, the series is non-stationary (i.e., it has a unit root).

The decision rule for the Augmented Dickey-Fuller (ADF) test is based on comparing the ADF statistic with critical values at standard significance levels (usually 1%, 5%, and 10%).

Compare the ADF Statistic to the critical values:

- If the ADF statistic is less than the critical value (more negative), reject the null hypothesis. This means the series is stationary.
- If the ADF statistic is greater than the critical value (less negative or positive), fail to reject the null hypothesis. This means the series has a unit root and is non-stationary.
- Where the Critical Values: 1%: -3.57, 5%: -2.92, 10%: -2.60.

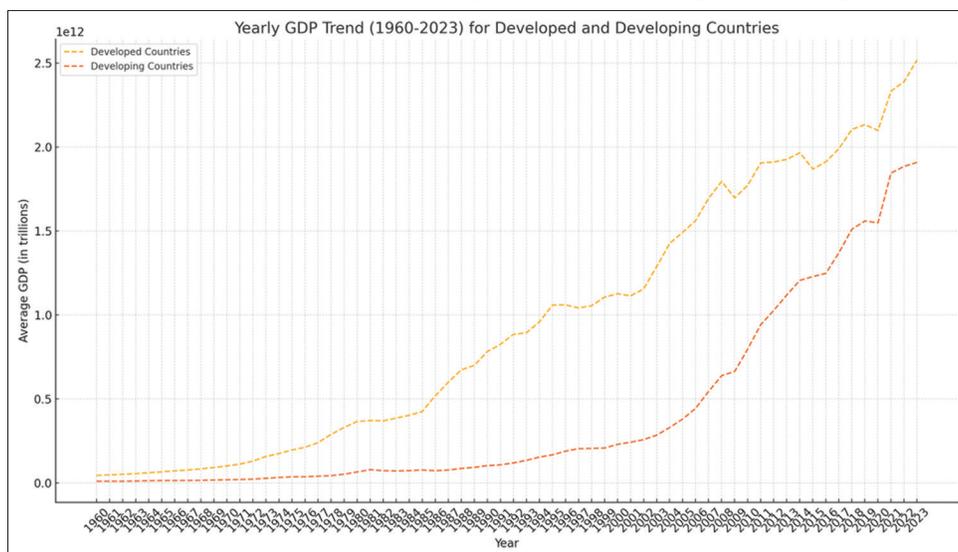
Use the P-value:

- If the P-value is less than the chosen significance level (e.g., 0.01, 0.05, or 0.10), reject the null hypothesis. The series is stationary.
- If the P-value is greater than the significance level, fail to reject the null hypothesis. The series is non-stationary.

### 4. RESULTS AND DISCUSSION

The results of the Augmented Dickey-Fuller (ADF) test based on GDP for the pre-COVID period (1960-2019) and the post-COVID period (2020-2023) provide crucial insights into the convergence between developed and developing countries as shown in Table 1.

**Figure 1:** Annual GDP trends (1960-2023): A comparison between developed and developing economies



**Table 1: The augmented Dickey-Fuller (ADF) test of economic convergence of the developed and developing nations**

Period	ADF statistic	P-value	Number of lags use	Number of observations used
Pre-COVID Era (1960-2019)	-1.78	0.39	8	51
Post-COVID Era (2020-2023)	-1.2	0.67	0	3

**4.1. Pre-COVID Period (1960-2019)**

The ADF test for the pre-COVID period revealed a P= 0.39, which is higher than the conventional significance levels of 0.01, 0.05, and 0.10. This indicates that the study fails to reject the null hypothesis, meaning there is no significant evidence of convergence between the GDP of developed and developing countries from 1960 to 2019. The fact that developed economies have historically experienced stronger growth, fueled by technological innovation, capital accumulation, and favorable institutional structures, may explain this lack of convergence (Kroeber, 2020; Guerrieri et al., 2022). The pre-COVID period saw these nations grow steadily due to elevated levels of consumption and investment, despite the periodic economic crises that punctuated this long-term growth (Mankiw, 2018).

Further supporting this, Barro and Sala-i-Martin (1992) note that convergence between economies tends to be conditional, where countries with similar initial conditions (such as technology and population growth) converge more easily than those with significant structural differences. In the case of the study’s pre-COVID analysis, the difference in industrialization, governance, and access to technology between developed and developing nations inhibited convergence, in line with Abramovitz’s (1986) theory that social capabilities are essential for economic catch-up.

**4.2. Post-COVID Period (2020-2023)**

The post-COVID period analysis returned a P= 0.67, which is even higher than the pre-COVID result, further reinforcing the decision

to fail to reject the null hypothesis. This indicates no significant convergence between developed and developing countries during the post-pandemic period. However, this result is based on a small sample size of just 3 years, limiting the robustness of this conclusion (Deaton, 2021).

The economic impact of the COVID-19 pandemic may have exacerbated existing disparities between developed and developing countries. While many developed nations were able to deploy economic stimulus measures and rapidly roll out vaccines, developing countries struggled with more significant challenges, such as access to resources and weak health infrastructure (Abraham and Vošta, 2022; United Nations, n.d.). This divergence in economic recovery could explain why the post-COVID analysis does not show evidence of convergence, as predicted by convergence theory.

The findings align with Brussevich et al. (2022), who argued that the pandemic has resulted in income divergence, with developing countries falling further behind. This suggests that, although the long-term trend for developing countries had been to grow faster, COVID-19 has potentially derailed this trajectory, with some developing nations facing deeper economic scarring from the pandemic.

The ADF test results for both the pre- and post-COVID periods suggest that there is no significant evidence of convergence between the GDPs per capita of developed and developing countries. The lack of convergence in the pre-COVID period aligns with historical economic disparities, while the post-COVID results may reflect the widening gap exacerbated by the pandemic. This is because between the two ADF statistics, -1.2 is worse in terms of indicating stationarity or convergence. A more negative ADF statistic (like -1.78) is closer to the threshold typically required to reject the null hypothesis of a unit root (non-stationarity), meaning it is slightly better in this context. However, -1.2 is closer to zero, which suggests weaker evidence for stationarity and a stronger likelihood that the series is non-stationary. Further research and data over a longer post-

COVID period will be needed to provide a more comprehensive understanding of the pandemic's long-term effects on global economic convergence.

## 5. CONCLUSION

The results suggest that there was no significant convergence between the GDPs of developed and developing countries both before and after the COVID-19 pandemic. However, it is important to note that the lack of convergence pre-COVID (1960-2019) is consistent with long-standing economic disparities between developed and developing nations, which may be due to structural differences in their economies, levels of industrialization, and access to resources. The post-COVID period (2020-2023) shows an even higher P-value, but this result is based on a very limited sample size (only 3 years). The short time frame might not provide a comprehensive picture of the pandemic's full economic effects.

The pandemic might have exacerbated existing economic inequalities between developed and developing countries. While developed countries were often better equipped to deploy economic stimulus measures and vaccines, many developing countries faced greater difficulties in managing the economic fallout of the pandemic. This may explain why the gap has persisted or widened post-COVID, as seen in the results where there is no indication of GDP convergence.

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