DO DEVELOPING COUNTRIES FACE THE "MIDDLE INCOME TRAP"? EVIDENCE FROM A NOVEL UNIT ROOT TEST

Aycan Hepsag[1]
Barış Erkan Yazici[2]

DOI: https://doi.org/10.31410/EMAN.S.P.2019.117

Abstract: *One of the recent and attractive subjects of the economic literature is the "middle income trap". The condition of middle income trap is defined for the countries which are categorized as middle income countries failing to move up to the high income category because of their slow growth rates. The present paper investigates the existence of middle income trap for developing countries which are Algeria, Belize, Brazil, Botswana, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Fiji, Gabon, Guatemala, Guyana, Jamaica, Jordan, Malaysia, Mexico, Paraguay, Peru, South Africa, St. Vincent and the Grenadines, Suriname, Thailand, Turkey and Venezuela, employing a novel unit root test with smooth break and nonlinear adjustment proposed by [3]. We follow the methodology of middle income trap proposed by [5] and determine the United States as the reference country. The data set involves annual gross domestic product (GDP) per capita of developing countries and the United States for the period from 1960 to 2017. Then, logarithmic per capita GDP gap series of each country is calculated in order to test the middle income trap for developing countries. The empirical results indicate that Belize, Botswana, Colombia, Costa Rica, Dominican Republic, Ecuador, Guyana, Jamaica, Jordan, Mexico, Peru, South Africa, St. Vincent and the Grenadines, Turkey and Venezuela are in the middle income trap. Therefore, we find out an evidence of a middle income trap in 15 out of 26 upper middle income countries.*

Keywords: *Middle income trap, developing countries, Hepsag Unit Root Test*

1. INTRODUCTION

The phenomenon of middle income trap (hereafter, MIT), which is firstly introduced by [1], is one of the recent and attractive subjects in economic literature. The term MIT commonly refers to countries that have experienced rapid growth, which enabled them to reach the status of a middle income country but have not been able to finally catch up to the developed countries and achieve high income status; instead, they became caught in the middle income range ([2]: 508-509). Therefore, it can be stated that for a middle income country, the expectation is not entering a status of recession after reaching a certain level of income.

The World Bank considers the "Atlas Method" for classification of the income categories of economies using GNI per capita levels. According to last calculation in 2017, the ranges for the GNI per capita are $995 or less for low-income economies; $996 and $3,895 for lower middle-income economies; $3,896 and $12,055 for higher-middle income economies and $12,056 or more for high-income economies. Based on these GNI per capita ranges, 34 countries are classified as low income, 47 countries are classified as lower-middle income, 56 countries are classified as upper-middle income and 81 countries are classified as high income economies for the current 2019 fiscal year.

[1] Istanbul University, Faculty of Economics, Department of Econometrics, Beyazit, 34452, Istanbul, Turkey
[2] Nişantaşı University, Faculty of Economics, Administrative and Social Sciences, Department of Economics and Finance, Turkey

The MIT phenomenon has gained increasing attention in recent years, but the MIT has primarily handled as a political discussion in theoretical framework. [2] stated that there exist two groups of the MIT definition; the first definition is "theoretical definition" and the second is the "empirical definition". Theoretical definition focuses on the necessary political and institutional regulations required when a middle income country enters the middle-income trap and defines the MIT as a result of neglecting structural and institutional reforms. (see, [1]; [3]; [4]). In other respects, [5] suggested a time series definition of the MIT that was based on the club convergence, so the MIT phenomenon became an empirically testable issue.

Specifically, the methodology of [5] defines a natural logarithmic difference series $x_{i,t}$ that can be denoted as the logarithmic per capita income gap, in order to determine whether or not a country enters the MIT:

$$x_{i,t} = y_{i,t} - y_{r,t} \tag{1}$$

where $y_{i,t}$ represents the natural logarithm of country i's per capita income in year t and $y_{r,t}$ is the natural logarithm of base country's per capita income in year t. Ordinarily, we focus on the logarithmic difference series $x_{i,t}$ for the convergence hypothesis as mentioned by [6] and if $x_{i,t}$ series tends to zero as $t \rightarrow \infty$, the countries have the same expected growth path in terms of income level so they are converging. Conversely, $x_{i,t}$ series equals to non-zero constant as $t \rightarrow \infty$ to satisfy the MIT condition and if a country is in the MIT, the expected growth path in terms of income level would be different.

Oppositely, when $x_{i,t}$ series follows a random walk process and so has a stochastic trend; this implies that the country is not a candidate for a MIT. If the logarithmic per capita income gap series, $x_{i,t}$ has a stochastic trend, we can express that the country i's per capita income is decomposed from the base country's per capita income so the country i is not a candidate for a MIT.

The examination of MIT phenomenon relies on the unit root tests in time series framework. There exist so limited empirical studies on the existence of the MIT in extant literature using unit root testing procedure.

[5] investigated the existence of MIT for middle income countries using Augmented Dickey-Fuller (ADF), [7] (ZA) and [8] (LP) unit root tests and they found out that seven countries (Cuba, El Salvador Lebanon, Peru, Syria, Turkey and Thailand) were candidates to be in the MIT. [9] explored the existence of MIT for Emerging-7 (E7) countries using linear and nonlinear unit root tests and their empirical findings support that the E7 countries do not fall into the MIT.

The goal of the present paper is to investigate whether or not the developing countries are in MIT employing a novel unit root test which considers jointly for smooth break and nonlinear adjustment proposed by [10]. The present paper suggests a new unit root test to investigate the MIT for middle income countries.

The organization of the paper is as follows: in section 2 we present the econometric methodology and section 3 contains the data description and empirical results of the paper. The fourth and last section includes conclusions.

2. ECONOMETRIC METHODOLOGY

Empirically, the existence of MIT could be tested by investing the stationary properties of the logarithmic per capita income gap series mentioned above through the unit root tests. If the logarithmic per capita income gap series of country *i* follows a stationary process, it would be implied that country *i* faces the MIT. It is well known that conventional unit root tests such as Augmented Dickey-Fuller (ADF) have weakness in terms of failure to reject the null of a unit root.

[10] proposes a novel unit root testing strategy which considers jointly for structural breaks and nonlinear adjustment. The structural breaks are modeled by means of a logistic smooth transition function and nonlinear adjustment is modeled by means of an exponential smooth transition autoregressive (ESTAR) model. At the approach [10], the null hypothesis of unit root is tested against the alternative hypothesis of the nonlinear exponential smooth transition autoregressive (ESTAR) stationarity with smooth break. We consider three logistic smooth transition models by following [10]:

$$\textbf{Model A: } y_t = \alpha_1 + \alpha_2 S_t(\lambda,\tau) + v_t \tag{2}$$

$$\textbf{Model B: } y_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\lambda,\tau) + v_t \tag{3}$$

$$\textbf{Model C: } y_t = \alpha_1 + \beta_1 t + \alpha_2 S_t(\lambda,\tau) + \beta_2 t S_t(\lambda,\tau) + v_t \tag{4}$$

$$S_t(\lambda,\tau) = \left[1 + \exp\left\{-\lambda\left(t - \tau T\right)\right\}\right]^{-1} \tag{5}$$

where Model A, B and C represent the smooth break in intercept, the smooth break in intercept under a deterministic trend and the smooth break both in intercept and trend, respectively. $S_t(\lambda,\tau)$ is the logistic smooth transition function, based on a sample of size *T*. The parameter τ determines the timing of the transition midpoint and the speed of transition is determined by the parameter λ.

Hepsag's unit root test suggests for calculating the test statistics via a two-step procedure. In the first step, the nonlinear least squares residuals are obtained as following.

$$\textbf{Model A: } \hat{v}_t = y_t - \hat{\alpha}_1 - \hat{\alpha}_2 S_t\left(\hat{\lambda},\hat{\tau}\right) \tag{6}$$

$$\textbf{Model B: } \hat{v}_t = y_t - \hat{\alpha}_1 - \hat{\beta}_1 t - \hat{\alpha}_2 S_t\left(\hat{\lambda},\hat{\tau}\right) \tag{7}$$

$$\textbf{Model C: } \hat{v}_t = y_t - \hat{\alpha}_1 - \hat{\beta}_1 t - \hat{\alpha}_2 S_t\left(\hat{\lambda},\hat{\tau}\right) - \hat{\beta}_2 t S_t\left(\hat{\lambda},\hat{\tau}\right) \tag{8}$$

After obtaining the nonlinear least squares residuals in the second step, we apply the unit root test of [11] to the residuals obtained in the first step. [10] allows for a nonzero location parameter *c* by following [11] in the ESTAR model as the following form:

$$\Delta\hat{v}_t = \gamma\hat{v}_{t-1}\left(1 - \exp\left\{-\theta\left(\hat{v}_{t-1} - c\right)^2\right\}\right) + \varepsilon_t \tag{9}$$

where $\hat{v}_t$ is the estimated nonlinear least squares residuals in the first step. [10] recommends an application of a first order Taylor approximation for equation (9) and obtains the auxiliary regression shown at equation (10).

$$\Delta\hat{v}_t = \delta_1\hat{v}_{t-1}^3 + \delta_2\hat{v}_{t-1}^2 + \sum_{i=1}^{p}\psi_i\Delta\hat{v}_{t-i} + \varepsilon_t \tag{10}$$

In the auxiliary regression (10), the null hypothesis could be constituted $H_0: \delta_1=\delta_2=0$ against $H_1: \delta_1<0, \delta_2\neq 0$. We denote the value of test statistics as:

$\tau_{SNL\alpha}$ if Model A is used to construct the $\hat{v}_t$,
$\tau_{SNL\alpha(\beta)}$ if Model B is used to construct $\hat{v}_t$ and
$\tau_{SNL\alpha\beta}$ if Model C is used to construct $\hat{v}_t$.

The $\tau_{SNL\alpha}$, $\tau_{SNL\alpha(\beta)}$ and $\tau_{SNL\alpha\beta}$ test statistics which are used in testing for a unit root hypothesis against nonlinear and stationary with smooth break are obtained as follows:

$$\tau_{SNL\alpha} = \tau_{SNL\alpha(\beta)} = \tau_{SNL\alpha\beta} = \left(\hat{\psi}_{22} - \frac{\hat{\psi}_{21}^2}{\hat{\psi}_{11}}\right)\left(\hat{\delta}_2 - \hat{\delta}_1\frac{\hat{\psi}_{21}}{\hat{\psi}_{11}}\right)^2 + 1\left(\hat{\delta}_1 < 0\right)\frac{\hat{\delta}_1^2}{\hat{\psi}_{11}} \tag{11}$$

where $\hat{\psi}_{22}$, $\hat{\psi}_{11}$ and $\hat{\psi}_{21}$ are the elements of Variance-Covariance matrix.

3. DATA AND EMPIRICAL RESULTS

The data set involves annual per capita gross national product (GDP in dollars) of 26 upper middle income countries for the period from 1960 to 2017 and consists of Algeria, Belize, Botswana, Brazil, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Fiji, Gabon, Guatemala, Guyana, Jamaica, Jordan, Malaysia, Mexico, Paraguay, Peru, South Africa, St. Vincent and the Grenadines, Suriname, Thailand, Turkey and Venezuela. The data are obtained from the World Bank Development Indicators database. We consider the base country as the United States so we collect the per capita GDP of the United States for the same period.

Then we calculate the logarithmic per capita income gap of each country as following:

$$x_{i,t} = \ln\left(\frac{per\ capita\ GDP_{i,t}}{per\ capita\ GDP_{US,t}}\right) \tag{12}$$

where per capita $GDP_{i,t}$ denotes the per capita GDP of country i in year t and $GDP_{US,t}$ represents the per capita GDP of the United States in year t.

We apply the [10] unit root test to per capita income gap of each country mentioned above considering Model C which allows the smooth break both in intercept and trend. The maximum lag length is determined through [12] as 10 and the optimal lag lengths are determined through the Akaike information criterion (AIC). The results of unit root test are presented at Table 1.[3]

[3] The WinRATS codes to employ empirical application are available upon request.

The unit root test results at Table 1 indicate that the null hypothesis of unit root cannot be rejected for Algeria, Brazil, China, Cuba, Fiji, Gabon, Guatemala, Malaysia, Paraguay, Suriname and Thailand at the 5% significance level. According to these results, there does not exist middle income trap in the upper middle income countries which are Algeria, Brazil, China, Cuba, Fiji, Gabon, Guatemala, Malaysia, Paraguay, Suriname and Thailand.

On the other hand, the null hypothesis of unit root is rejected for Belize, Botswana, Costa Rica, Dominican Republic, Jamaica, Mexico, Peru, South Africa, St. Vincent and the Grenadines and Turkey at the 5% significance level and is rejected for Colombia, Ecuador, Guyana, Jordan and Venezuela at the 10% significance level.

Based on the empirical results, it can be implied that the logarithmic per capita income gap of these countries follows a nonlinear ESTAR stationary process with smooth break. Thereby, Belize, Botswana, Colombia, Costa Rica, Dominican Republic, Ecuador, Guyana, Jamaica, Jordan, Mexico, Peru, South Africa, St. Vincent and the Grenadines, Turkey and Venezuela countries are in MIT.

Countries	Lag-Length	$\tau_{SNL\alpha\beta}$
Algeria	3	8.52149
Belize	1	28.92616*
Botswana	1	17.42442*
Brazil	2	9.48930
China	1	9.19763
Colombia	3	11.63384**
Costa Rica	3	15.22618*
Cuba	0	6.05391
Dominican Republic	5	23.03184*
Ecuador	3	10.85712**
Fiji	1	8.60288
Gabon	7	10.38980
Guatemala	0	6.17246
Guyana	0	11.83311**
Jamaica	2	29.07311*
Jordan	4	11.44866**
Malaysia	1	8.73537
Mexico	1	18.15259*
Paraguay	8	5.01457
Peru	5	14.45783*
South Africa	1	27.97768*
St. Vincent and the Grenadines	1	32.37432*
Suriname	2	2.31558
Thailand	1	9.33488
Turkey	0	32.96011*
Venezuela	2	10.65671**

Table 1: The Results of Hepsag Unit Root Test

Notes: * and ** indicates the rejection of the null of unit root at the 5% and 10% significance levels, respectively. The optimal lag lengths are determined through the Akaike information criterion (AIC).

4. CONCLUSION

The purpose of the present study is to investigate whether or not the developing countries are in middle income trap (MIT) employing a novel unit root test which considers jointly for smooth break and nonlinear adjustment proposed by [10]. The present paper suggests a new unit root test to explore the MIT for middle income countries.

The data set involves annual per capita gross national product (GDP in dollars) of 26 upper middle income countries for the period from 1960 to 2017 and consists of Algeria, Belize, Botswana, Brazil, China, Colombia, Costa Rica, Cuba, Dominican Republic, Ecuador, Fiji, Gabon, Guatemala, Guyana, Jamaica, Jordan, Malaysia, Mexico, Paraguay, Peru, South Africa, St. Vincent and the Grenadines, Suriname, Thailand, Turkey and Venezuela. We consider the base country as the United States so we collect the per capita GDP of the United States for the same period. Then we calculate the logarithmic per capita income gap of each country in order to test MIT.

The empirical results indicate that Belize, Botswana, Colombia, Costa Rica, Dominican Republic, Ecuador, Guyana, Jamaica, Jordan, Mexico, Peru, South Africa, St. Vincent and the Grenadines, Turkey and Venezuela are in the middle income trap. We find out an evidence of a middle-income trap in more than half sample of developing countries. Therefore, we find out an evidence of a middle income trap in 15 out of 26 upper middle income countries. We can suggest for these countries focusing on the required political and institutional regulations to exit the middle income trap.

REFERENCES

[1] Gill, I., Kharas, H. (2007) *An East Asian Renaissance–Ideas for Economic Growth*. World Bank, Washington, DC.
[2] Glawe, L., Wagner, H. (2016) The Middle-Income Trap: Definitions, Theories and Countries Concerned-A Literature Survey. *Comparative Economic Studies*, 58 (4), pp. 507-538.
[3] Ohno, K. (2009) Avoiding the Middle-Income Trap-Renovation Industrial Policy Formulation In Vietnam. *ASEAN Economic Bulletin*, 26 (1), pp. 25-43.
[4] Kharas, H., Kohli, H. (2011) What is the Middle Income Trap, Why Do Countries Fall into it, and How can it be Avoided? *Global Journal of Emerging Market Economies*, 3 (3), pp. 281-289.
[5] Ye, L., Robertson, P. E. (2016) On the Existence of Middle-Income Trap, *Economic Record*, 92 (297), pp. 173-189.
[6] Bernard, A. B., Durlauf, S. N. (1995) Convergence in International Output, *Journal of Applied Econometrics*, 10 (2), pp. 97-108.
[7] Zivot, E., Andrews, D. W. K. (1992) Further Evidence on the Great Crash, the Oil-Price Shock, and the Unit-Root Hypothesis. *Journal of Business and Economic Statistics*, 10 (3), pp. 251–270.
[8] Lumsdaine, R. L., Papell, D. H. (1997) Multiple Trend Breaks and the Unit-Root Hypothesis. *Review of Economics and Statistics*, 79 (2), pp. 212-218.
[9] Tiftikçigil, B. Y., Güriş, B., Yaşgül, Y. S. (2018) Does middle income trap exist?: Evidence from Emerging Economies: E7 Countries for 1969-2015. *Revista Galega de Economia*, 27 (1), pp. 145-158.
[10] Hepsag, A. (2019) A Unit Root Test Based on Smooth Transitions and Nonlinear Adjustment. *Communications in Statistics-Simulation and Computation*, pp. 1-8.
[11] Kruse, R. (2011) A New Unit Root Test against ESTAR Based on a Class of Modified Statistics. *Statistical Papers*, 52 (1), pp. 71-85.
[12] Schwert, G. W. (1989) Tests for Unit Roots: a Monte Carlo Investigation. *Journal of Business & Economic Statistics*, 7, pp. 147-160.