frontiers | Frontiers in Environmental Science

ORIGINAL RESEARCH
published: 29 August 2022
doi: 10.3389/fenvs.2022.937405

Evidence of the Middle-Income Trap in Latin American Countries: Factor Analysis Approach Using Regression and the ARDL Model

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Specialty section:
This article was submitted to Environmental Economics and Management, a section of the journal Frontiers in Environmental Science

Received: 06 May 2022
Accepted: 13 June 2022
Published: 29 August 2022

Citation:
Galvan LPC, Campo CC, Stanojevic S and Alzate DV (2022) Evidence of the Middle-Income Trap in Latin American Countries: Factor Analysis Approach Using Regression and the ARDL Model. Front. Environ. Sci. 10:937405. doi: 10.3389/fenvs.2022.937405

The middle-income trap (MIT) is often accompanied by the decline or stagnation of economic growth, unreasonable domestic industrial structure, and serious polarization between the rich and the poor. However, due to different international environments, different specific national conditions, and different development policies adopted by each country, how to get out of the MIT varies. This study carries out an analysis of different economic growth factors of Latin American countries (we selected 19 MIT countries out of 33) and compared them with Singapore and Korea, which are in a high-income range. We used a regression model to find the relationship of variables in each country and the impact on the economic growth due to these variables. The study finds using correlation and regression analysis, that trade and foreign direct investment (FDI) play a major role in avoiding the MIT by having a strong regression (R^2 = 1.481*** for S. Korea, R^2 = 0.65 for Singapore) with the gross domestic product (GDP) for high-income countries while having a weak regression in Latin American countries. Another factor is that industrialization and services export play a vital role in avoiding the MIT in Singapore and South Korea, and the same model should be used in Latin American countries to avoid the MIT. Furthermore, using the panel ARDL model we validated the results of a regression model and established that similar factors are impacting Latin American countries' MIT. Correlation analysis is used to determine the relationship of selected factors and their impacting strength on the growth of an economy. In the final section, we present Latin American countries, and their main policy gaps according to their unique characteristics and recommend a policy with suggestions for avoiding the MIT by comparing their economies with those of high-income countries.

Keywords: middle-income trap, Latin America, ARDL model, regression, factor analysis

1 INTRODUCTION

The concept of the "middle-income trap" (MIT) has gradually become familiar to development agencies and policymakers. MIT refers to a state in which the per capita income level of a country (region) cannot change smoothly after reaching the middle-income level, resulting in economic stagnation (Yavuz Tiftikçigil et al., 2018). Middle-income countries caught in the trap lose their competitive edge with low-income countries in industries that require a lot of cheap labor, can't compete with high-income countries in R&D-intensive industries, and lose their economic growth momentum (Dui, 2020). A country must avoid or escape this trap, otherwise, it cannot become a fully developed economy. Among the 101 middle-income economies in 1960, only 15 entered the high-income economy by 2014, while other countries or regions remained in the middle-income stage, and some even returned to the low-income stage (Cherif and Hasanov, 2019).

Many economies can easily grow from a low-income country to middle-income country, but it is difficult to cross the middle-income stage and become a high-income country. Latin American countries such as Brazil, Argentina, and Mexico jumped from low-income countries to middle-income countries in a very short period, creating a miracle of growth in the national economy and per capita income, but they experienced economic regressions one after another between 1970 and 1980 (Silva, 2018). Among Asian economies, only Japan has successfully overcome the "middle-income trap" and achieved a leap in economic development. After being hit by the Asian financial turmoil, Indonesia, the Philippines, India, and other countries have remained in the middle-income ranks because they could not resume their previous prosperous economic development (Paus, 2018). MIT is a common economic phenomenon that occurs in countries with different historical, cultural, and economic backgrounds, accompanied by declining economic growth and fragile financial systems. To help countries avoid falling into or escape from the MIT many research institutions and scholars have studied its development theories, causes, and avoidance mechanisms (Kotarski and Petak, 2019). Keep in view the significance of MIT the countries should focus on different economic parameters.

A similar issue of MIT has been observed in Latin America due to a low focus on growth factors. Latin American countries were all historically colonies of European countries, and it was not until the 19th and 20th centuries that independent governments were gradually established. Therefore, the economic development of these countries started relatively late. Despite a late start, Latin American countries have their economic advantages. In the process of economic construction, Latin American countries can rely on the advantages of low labor costs and abundant natural resources to gain benefits in the international market. Relying on unique natural conditions and cheap labor, many Latin American countries have achieved excellent economic results in the export of agricultural products, mineral mining, machinery industry, etc., and completed the process from poverty and adverse conditions to poverty alleviation and prosperity (Ortiz et al., 2018). However, as the nation's wealth grows, so does the labor income, and increasingly, machines could replace human labor. Thus, the labor advantage of Latin American countries is gradually disappearing which is a major cause of MIT in Latin American countries.

Several studies highlight different causes of MIT in Latin American countries. Failure to develop a high-quality labor force is one of the reasons why Latin American economies are gradually losing their edge. To improve the quality of the labor force, it is necessary to strengthen investment in education and scientific research and encourage high technology. Nevertheless, following the economic development of Latin American countries, little attention has been paid to education. The illiteracy rate remains high, and ordinary people who wish to go to school cannot afford tuition fees. Conversely, child labor is rampant in Latin America (Máttar, 2019). Many people cannot afford to send their children to school, so their only option is to let their children go out to work early. In addition, economic growth leads to a widening gap between the rich and the poor. The rich occupy most of society's property and monopolize a large number of social resources and relationships. They can quickly realize "money begets money" through investment and other means. The poor can only earn income by selling their labor, which remains constant. Therefore, if matters continue in such a way, the gap between the rich and the poor will widen.

Many Latin American countries have managed to improve the national economy but have failed to narrow the gap between the rich and the poor and provide social welfare. Latin America, where child labor is rampant, has never had strict labor laws, and ordinary people generally have to pay for services such as education, pensions, and public facilities. The widening gap between the rich and the poor can easily create a social crisis. Under such social conditions, left-wing governments representing the interests of the middle and lower classes usually gain more support and replace the original government. The left-wing government may not perform well in driving economic growth, and it may gradually lose the trust of voters.

The MIT is not only an issue for Latin American countries; it is also a great challenge worldwide. **Figure 1** shows the change of the MIT in the last few years, and it highlights higher-income countries decreasing in the MIT and middle-income countries sustaining the MIT together with similar and a consistent number of countries. A country must avoid or escape the MIT, otherwise, it will be unable to become a fully developed economy. Among 101 middle-income economies in 1960, only 15 had entered a high-income economy by 2014, while other countries or regions remained in the middle-income stage, and some even returned to the low-income stage (Rowe et al., 2018). Many economies can easily grow from a low-income countries to middle-income country; however, it is difficult to bridge the middle-income stage and become a high-income country (Canuto, 2019). Latin American countries such as Brazil, Argentina, and Mexico escalated from low-income countries to middle-income countries in a very short period, creating a miraculous growth in the national economy and per capita income; nevertheless, they experienced economic regressions continually between 1970 and 1980 (Lee and Kim, 2018). Among Asian economies, only Japan has successfully overcome the "middle-income trap" and achieved a leap in economic development (Hartwell, 2018). After being hit by the Asian financial turmoil in 1997, Indonesia, the Philip-pines, India, and other countries have remained in the middle-income ranks as they could not resume their previous prosperous economic development (Estrada et al., 2018).

Different researchers around the globe highlight these MIT issues in different studies with causes and avoidance mechanisms. Oreiro et al. (2020) proposed the development of a list model that highlights how natural resources and an external savings growth strategy may

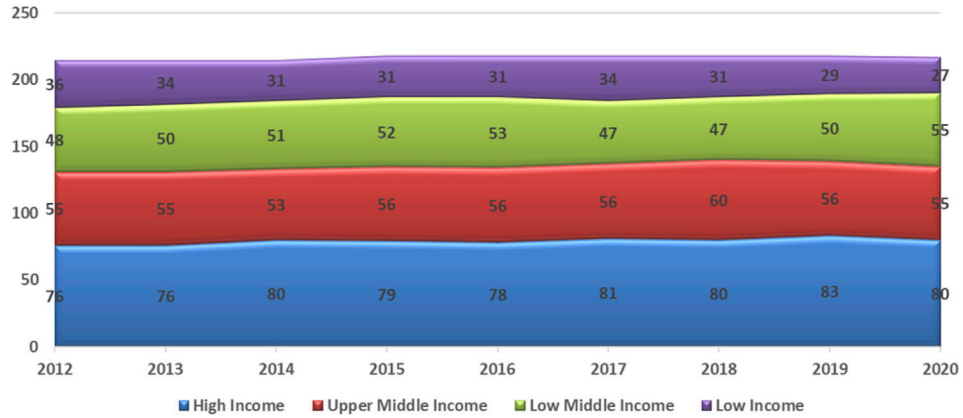

FIGURE 1 | Change of income level in all countries from 2012 to 2020.

lead to an exchange rate overvaluation. Lebdioui et al. (2021) find how Chile and Malaysia escaped from the MIT by focusing on foreign direct investment (FDI), trade (petroleum, rubber, etc.), and research and development (R&D). Justine et al. highlight that industrialization and increasing production have a huge impact on escaping from the MIT in different countries (Lin and Wang, 2020). Vidra et al. focused on the analysis of the impact of science and technology (S&T) development in high-income countries and shows that S&T growth is one of the major components that can help in escaping from the MIT (Klingler-Vidra and Wade, 2020). The MIT is a ubiquitous economic phenomenon and even if not all countries or regions fall into the MIT, they will always be affected by the MIT to varying degrees in the process of their economic development. In addition to the MIT occurring in developing countries, similar phenomena have also occurred in some developed countries, such as the United States and the United Kingdom, in the early stages of development (Ozturk, 2016).

The fundamental reason for the occurrence of the MIT is the mechanism that supported economic growth in the past was unsustainable. Eichengreen et al. (2013) show that if a country wishes to make a breakthrough in economic development and enter the ranks of high-income countries, it needs to change its stagnant or even retrogressive economic state, adjust the backward growth mechanism, and inject new impetus into economic development. From the perspective of international trade, Han and Wei (2017) highlight to avoid MIT the countries should focus on rapid social and economic development, middle-income countries have ushered in development opportunities. Once the economy grows to a certain level, the advantages of labor no longer exist, and labor remuneration continues to increase; however, the economic structure has not been upgraded, and international competitiveness has been further weakened. Therefore, the international trade situation has not only failed to improve year-on-year, but has deteriorated, and the industrial structure has not been improved. To optimize and adjust, economic development has fallen into difficulties, which has caused social turmoil and intensified social contradictions, and the economic development of middle-income countries has fallen into difficulties. Ohno (2009) suggest that foreign trade is the best way to connect the internal economy with the external economy. Improving the foreign trade structure can help solve the problems encountered in the process of industrial structure optimization.

Different researchers used different statistical methods for relationship extraction, e., Irfan et al. (2022) used AHP and G-TOPSIS approach to finding energy barriers. Tang et al. (2022) used the ARDL model for finding the relationship between natural resources and financial growth. Xie et al. (2022) used a frequency-domain approach to get the relationship between economic performance on forest resources. Irfan et al. (2022) in another work investigate the impact of trilemma energy by using correlated panel corrected standard errors (PCSEs) (Khan et al., 2022a). Other studies (Muhammad and Khan, 2021; Khan et al., 2022b; Shahzad et al., 2022; Zhang et al., 2022) also highlight the statistical approaches to get the relationship between different variables. Therefore, this study used regression, correlation, and panel ARDL models to find the relationship between variables of MIT. Bhatti et al. (2022), Bhatti et al. (2021) used regression and correlation models to extract the relationship between variables. Therefore, this study used Correlation, regression and panel ARDL model to extract the relationship.

In the context of the globalized economy, it is of practical significance to actively turn the perspective to the external economy and explore ways to optimize the industrial structure through trade structure optimization. Keeping in view the significance of MIT and how to escape that in Latin American countries, this study's main contributions and objectives are:

- This study attempts to study the factors that affect countries falling into the MIT from the perspective of trade, health, education, and investment (FDI), and puts forward policy recommendations based on the research conclusions to help the country's economy achieve sustainable growth.
- This study finds the influence mechanism of different economic factors such as health, FDI, education, and trade structure on the income level of trapped (Latin American) countries and non-trapped countries

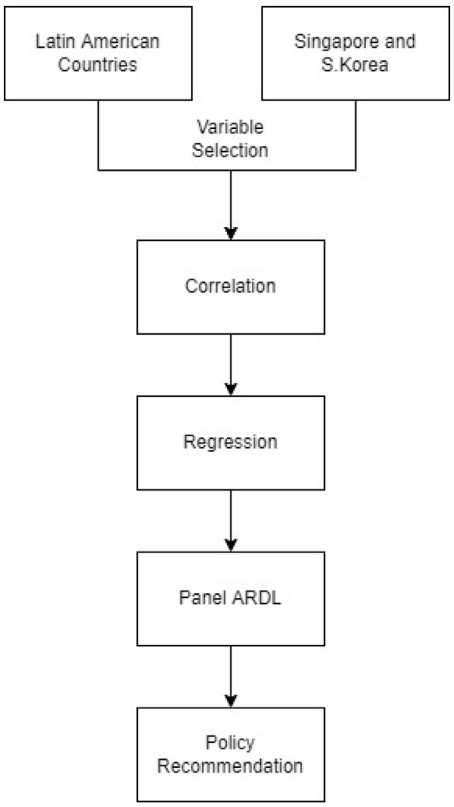

FIGURE 2 | Flowchart of the proposed study.

(Singapore and Korea). This study helps affected countries to optimize trade structure, transform industrial structure, adjust economic development mode, and achieve sustainable growth.
- Based on different statistical analyses like regression, correlation, and autoregressive models this study compares the high-income countries such as Singapore and Korea with MIT countries of Latin America.

1.1 Research Questions

This research addresses the sustainability and current economic performance of Latin American countries by highlighting the indicators that need to be focused on for avoiding the MIT. The following research gaps were identified, which are lacking in other studies, and our study kept a focus on these gaps:

- What are the basic indicators for economic development that need to be focused on by Latin American countries to escape the MIT?
- Which indicators of high-income countries are resulting in a better impact for avoiding the MIT?
- What is the economic development progress in Singapore and Korea towards sustainability in the MIT?

TABLE 1 | List of selected countries with income level and region.

Country name	Income level	Region
Argentina	Upper middle income	Latin America
Belize	Lower middle income	
Bolivia	Lower middle income	
Brazil	Upper middle income	
Colombia	Upper middle income	
Costa Rica	Upper middle income	
Dominica	Upper middle income	
Dominican Republic	Upper middle income	
Ecuador	Upper middle income	
Grenada	Upper middle income	
Guatemala	Upper middle income	
Guyana	Upper middle income	
Honduras	Lower middle income	
Jamaica	Upper middle income	
St. Lucia	Upper middle income	
Mexico	Upper middle income	
Nicaragua	Lower middle income	
Panama	Upper middle income	
Peru	Upper middle income	
Paraguay	Upper middle income	
El Salvador	Lower middle income	
Suriname	Upper middle income	
Venezuela, RB	Lower middle income	
Korea, Rep	High income	
Singapore	High income	Southeast Asia

- How do correlation, regression, and the Auto Regressive Distributed Lag (ARDL) model help to determine the most impacting factors among all Latin American countries?
- What are our policy recommendations for governments, stakeholders, business owners, etc.?

2 MATERIALS AND METHODS

Complete flowchart of this study implementation as shown in **Figure 2**:

2.1 Study Area

Latin America refers to Central America, the Caribbean, and South America, all south of the United States. It is named for the fact that most countries use Spanish and Portuguese, both of which belong to the Latin family, as their national languages (Heinicke et al., 2007). Located in the central and southern parts of the Western Hemisphere, it is bordered by the Atlantic Ocean in the east, the Pacific Ocean in the west, bordering North America (United States) in the northwest, and facing Antarctica across the Drake Passage in the south. There are a total of 33 countries in Latin America, out of which we selected a total of 19 countries and categorized them according to their income level i.e., upper middle-income and lower middle-income (Goldie et al., 2008). We selected two higher income countries, Singapore, and Korea, as models for comparison as they had escaped the MIT. **Table 1** shows the list of the selected countries. **Figure 3** shows the geographic location of countries.

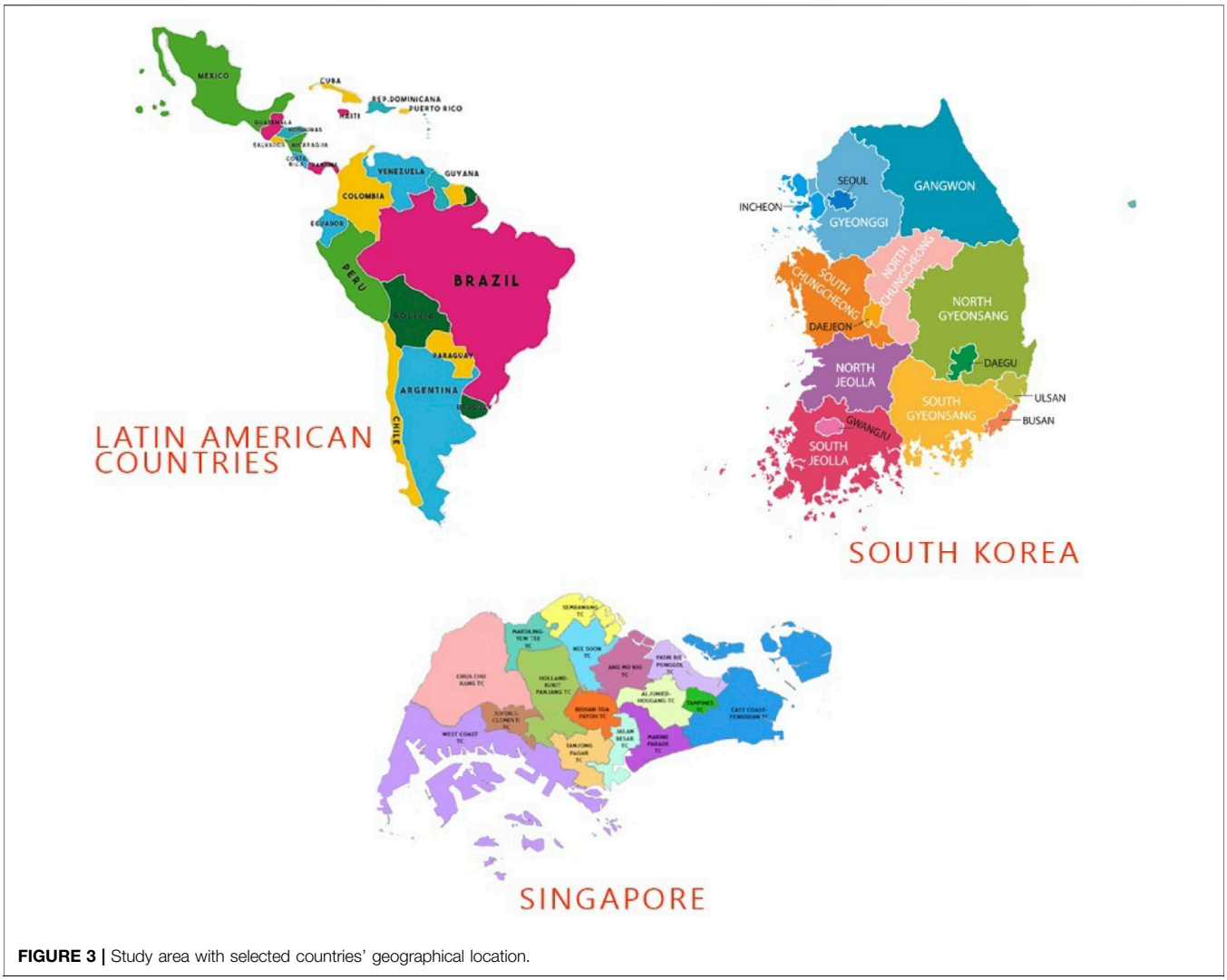

FIGURE 3 | Study area with selected countries' geographical location.

2.2 Data Selection

Data for different factors has been selected from the World Bank website for the period from 2000 to 2020 for the selected countries (World Bank). The focused factors that impact MIT are education, health, GDP, travel services/tourism, trade [high-technology exports, information and communication technology (ICT) exports etc.], and foreign direct investment (FDI). Descriptive analysis of the data is shown in **Table 2**. Statistical analysis of the data was performed using SPSS software (version 25; IBM).

2.3 Regression Model

A regression model is a method of statistical analysis that studies the dependence of a dependent variable on an independent variable in regression, with the aim of estimating or predicting the mean of the dependent variable from a given value of the independent variable. It can be used for forecasting, modeling time series, and discovering causal relationships between various variables (Florax and de Graaff, 2004). This study utilized the regression model to predict the impact of variables on the growth of economic development. The benefits of using regression analysis are as follows:

1) It indicates a significant relationship between the independent variable and the dependent variable.
2) It indicates the strength of the influence of multiple independent variables on a dependent variable.

Regression analysis can also be used to compare the interaction between variables measured by different measures, such as the link between price changes and the number of promotions. These benefits allow market researchers, data analysts, and data scientists to exclude and measure the best set of variables for building predictive models.

The simplest regression model can be represented as the data object to be fitted is $X = \{x_1, x_2, \ldots, x_m\}$, the corresponding real value is $Y = \{y_1, y_2, \ldots, y_m\}$, the linear model can be written as:

$$\hat{y} = Xw \tag{1}$$

TABLE 2 | Descriptive statistical data.

Countries	Descriptive statistics	Education (US$)	Health expenditure	GDP (current US$)	Travel services	High-technology exports (US$)	Service exports (US$)	FDI (US$)
Latin American Countries	Mean	93.13	6.16	1.71E + 11	8.34	43891276	47534758	−5485593
	Median	95.76	5.85	2.23E + 10	4.19	0.44	542.41	95.05
	Standard Deviation	7.08	1.43	4.03E + 11	17.05	25708751	2.34E + 09	2.09E + 09
	Minimum	60.89	3.06	3.01E + 10	−3.09	0	145.81	−1.4E + 10
	Maximum	100	10.44	33.01E + 10	254.95	2.015E + 09	1.55E + 10	100
Singapore	Mean	94.26	3.52	2.302E + 11	1.49	0.32	2573.43	88.15
	Median	95.67	3.35	2.4E + 11	0.96	0.32	2321.71	87.8
	Standard Deviation	3.64	0.48	1.025E + 11	1.92	0.05	950.44	3.08
	Minimum	87.75	2.84	8.979E + 10	−0.53	0.24	1384.79	83.37
	Maximum	97.84	4.39	3.76E + 11	6.63	0.43	4102.27	93.78
Korea	Mean	85.93	5.72	1.168E + 12	2.33	2.94	1851.67	82.25
	Standard Error	0.17	0.27	8.237E + 10	0.27	0.19	185.6	0.19
	Median	85.93	5.85	1.173E + 12	2.26	2.93	1792.55	82.25
	Standard Deviation	0.24	1.21	3.775E + 11	1.22	0.84	830.02	0.26
	Maximum	86.1	8.16	1.725E + 12	4.67	4.21	3521.33	82.44

Where w is the regression coefficient, we use a square error to measure the fitting error:

$$L(X) = \sum_{i=1}^{m} \left(y_i - x_i^T w\right)^2 = \left(y - Xw\right)^2 \tag{2}$$

The above formula is equal to 0 to the w.

$$\frac{\partial L(X)}{\partial w} = \frac{\partial \left(y^T y - w^T X^T y - y^T X w - w^T X^T X w\right)}{\partial w} = 2X^T \left(y - Xw\right) = 0 \tag{3}$$

It can determine:

$$\hat{w} = \left(X^T X\right)^{-1} X^T y \tag{4}$$

The above is easy to interact with training data; a good solution is partial weighted linear regression, increasing a weight w_i for each error (here w is not the above $\hat{w}$), at this time, the error function can be written:

$$L(X) = \sum_{i=1}^{m} w_i \left(y_i - x_i^T w\right)^2 = \left[W\left(y - Xw\right)\right]^2 \tag{5}$$

Among them, W is a diagonal matrix, also called the core; the type of core can choose freely, and the most common is the Gaussian nucleus. The weight corresponding to the Gaussian nucleus is as follows:

$$W(j, j) = \exp\left(\frac{\left\|x^i - x^j\right\|^2}{-2k^2}\right) \tag{6}$$

Similarly, the new error function $L\ (X)$ is governed to obtain the regression coefficient at this time:

$$\hat{w} = \left(X^T W X\right)^{-1} X^T W y \tag{7}$$

The W here is actually $W^T W$, but using W replaces the same meaning and is simple.

2.4 Granger Causality Test

This analysis is to test the causality of the time series data, and this model was established by Granger (1969) (Engle and Granger, 1987). A variable x_t is caused by y_t, incase if it can forecast the x_t with greater number of accuracy with the usage of y_t past value. The first step of this test is the calculation by the VAR model and given as follows:

$$y_t = \alpha_1 + \sum_{i=1}^{n} \beta_i x_{t-i} + \sum_{j=1}^{m} \beta_j y_{t-j} + e_{1t} \tag{8}$$

$$x_t = \alpha_2 + \sum_{i=1}^{n} \delta_i x_{t-i} + \sum_{j=1}^{m} \delta_j y_{t-j} + e_{2t} \tag{9}$$

Where e_{1t} and e_{2t} are known as the uncorrelated white noise error expressions. Here null hypothesis shows that x_t is not caused by y_t. If there is a situation that value of F computed > F critical value, thenceforth, the null hypothesis rejected, and it is finalized that x_t is caused by y_t.

2.5 Panel Auto Regressive Distributed Lag Model

ARDL model has been in use for decades to model the relationship between economic variables in a single-equation time series setup. Its popularity also stems from the fact that cointegration of nonstationary variables is equivalent to an error correction (EC) process, and the ARDL model has a reparameterization in EC form (Hassler and Wolters, 2006). The existence of a long-run/cointegrated relationship can be tested based on the EC representation. A bounds testing procedure is available to draw conclusive inference without knowing whether the variables are integrated of order zero or one, I (0) or I (1), respectively (Pesaran et al., 2001).

The regression model studies the analysis of univariate series, while the ARDL model, models multivariate time series. In the ARDL model, there is not only the lag part of the original data,

but also other influencing factors are added to adjust the autoregressive results. The method is simple and effective for small samples or limited sample data. Its general expression is:

$$B(L,P)y_t = \sum_{i=1}^{k}\beta_i(B,q_i)x_{it} + u_t \tag{10}$$

Among,

$$B(L,P) = 1 - \varphi_1 B - \varphi_2 B^2 - \ldots - \varphi_p B^p \tag{11}$$

$$\beta_i(B,q_i) = 1 - \beta_{i1}B - \beta_{i2}B^2 - \ldots - \beta_{iq_i}B^{q_i} \tag{12}$$

In **Eqs 11**, **12**, P represents the delay order of the explanatory variable y_t, q_i represents the delay order of the *i-th* explanatory variable x_{it}, $i = 1, 2, \ldots, k$. B is the delay operator, u_t is the random item. ARDL models are generally written as:

$$y_t = \sum_{i=1}^{p}\varphi_i y_{t-i} + \sum_{j=1}^{k}\sum_{l_j=0}^{q_j}\beta_{jl_j}x_j, t - l_j + u_t \tag{13}$$

The ARDL model is widely used for a multivariate time series model, and it requires less data; it is a simple idea, and it is a good model construction method.

Traditional panel data analysis assumes that the relationship between Y and X is homogeneous for all individuals, and the heterogeneity is mainly reflected in the intercept term. When we examine the dynamic panel data model, the variable intercept model can be written as:

$$Y(it) = aY(it-1) + bX(it) + c(i) + u(it), \tag{14}$$

where i represents the i-th cross-sectional unit, t represents the observation value of the t-th period, and $c(i)$ is the intercept term that changes with individual i. The estimation method of model parameters a and b is to use the system GMM or difference GMM method introduced in the last tweet. In this article, Pesaran et al. (1999) assumed that all coefficients may vary with individual i, so not only the intercept but also the slope, such as:

$$Y(it) = a(i)Y(it-1) + b(i)X(it) + c(i) + u(it), \tag{15}$$

The reason why this heterogeneous panel model is considered is that in macroeconomic research, unobservable factors such as the institutional culture of each region or country often show systematic differences, and these differences will not only affect the intercept term $c(i)$, may also affect the sensitivity of Y to changes in X.

Panel Auto Regressive Distributed Lag (ARDL) model or Pooled Mean Group (PMG) technique for analyzing non-stationary dynamic panels was given by Pesaran and Shin (1995), Pesaran et al. (1999). PMG has both averaging and pooling, hence it is considered as an intermediate estimator between Dynamic Fixed Effect (DFE) and Mean Group (MG). PMG has an advantage over the Dynamic OLS model that it allows the short run dynamic specification to differ among cross section, while the long run coefficients are constrained to be the same. Hence, panel ARDL/PMG model is used to investigate the heterogeneous dynamic issue across cross sections as well as to estimate the long and short run relationship among variables. So, panel ARDL/PMG model can be specified as:

$$Y_{it} = \sum_{j=1}^{p}\lambda_{ij}Y_{i,t-j} + \sum_{j=0}^{q}\delta'_{ij}X_{i,t-j} + \mu_i + \varepsilon_{it} \tag{16}$$

Where, Y_{it} reports dependent variable, X_{it} represents (k × 1) vector of explanatory variables, μ_i shows the fixed effects, λ_{ij} shows the coefficient of the lagged dependent variable, δ_{ij} represents (k × 1) coefficient vector of independent variables, ε_{it} denotes the error tern, i (1, 2, . . ., N) is number of cross section, and t (1, 2, . . ., T) is number of time.

3 RESULTS AND DISCUSSION

A generally accepted view as to the cause of the MIT is: that with economic growth, labor costs increase, and the comparative advantage of cheap labor costs is lost; a new economic growth model guided by knowledge and innovation has not yet been formed, thus making economic growth momentum insufficient. Therefore, the causes of the MIT can be roughly divided into the following three levels: first, the direct impact variables of sustained economic growth, such as health (Paus, 2014), education, industrial structure (Kanchoochat, 2014) and its changes; second, the internal and external environmental variables affecting economic growth, such as trade (Engel and Taglioni, 2017), macroeconomic policies, demographic factors (Jayasooriya, 2017), and FDI (Nguyen-Huu and Pham, 2021); and the third is the fundamental reason that affects long-term economic performance, such as social and economic systems, for example, tourism and services. In view of this, education, health expenditure, travel services, high-technology exports, service exports, and FDI are selected as independent variables affecting a country's per capita GDP, and economic growth is represented by per capita GDP (y) as a dependent variable.

According to the above analysis, with *ln(free)*, *ln(open)*, *ln(con)*, *ln(ind)*, *ln(hon)*, *ln(tec)*, *inf*, *ln(lab)*, *ln(inv)* and *ln(ci)* as the independent variables and *ln(y)* as the dependent variable, establish the following panel data econometric model:

$$\begin{aligned} In(y_{it}) = {} & c_0 + \alpha_i + c_1 ln(tec_{it}) + c_2 ln(free_{it}) + c_3 inf_{it} \\ & + c_4 ln(open_{it}) + c_5 ln(hea_{it}) + c_6 ln(edu_{it}) \\ & + c_7 ln(inv_{it}) + c_8 ln(ind_{it}) + c_9 ln(hon_{it}) \end{aligned} \tag{17}$$

where i represents the countries' element, i = 1, 2, in the "trap group" country model. . . , 14 (here Singapore and Korea are also considered for evaluation); i = 1, 2, . . . , 26, t represents time, c_0 is the intercept term, and α_i is the difference intercept term. $In(y_{it})$ is the logarithm of a country's per capita GDP, $ln(tec_{it})$ is the logarithm of a country's technological level, $ln(free_{it})$ is the logarithm of economic freedom, and inf_{it} is the logarithm of the inflation rate. $ln(open_{it})$ represents the logarithm of the proportion of trade volume in GDP, $ln(hea_{it})$ represents the logarithm of health, $ln(edu_{it})$ represents the logarithm of the proportion of education in GDP, $ln(inv_{it})$ represents the logarithm of the proportion of FDI in GDP, $ln(ind_{it})$ represents the logarithm of the proportion of secondary industry output in GDP, $ln(ci_{it})$ is the logarithm of the urbanization rate, and ε_{it} is the random error term.

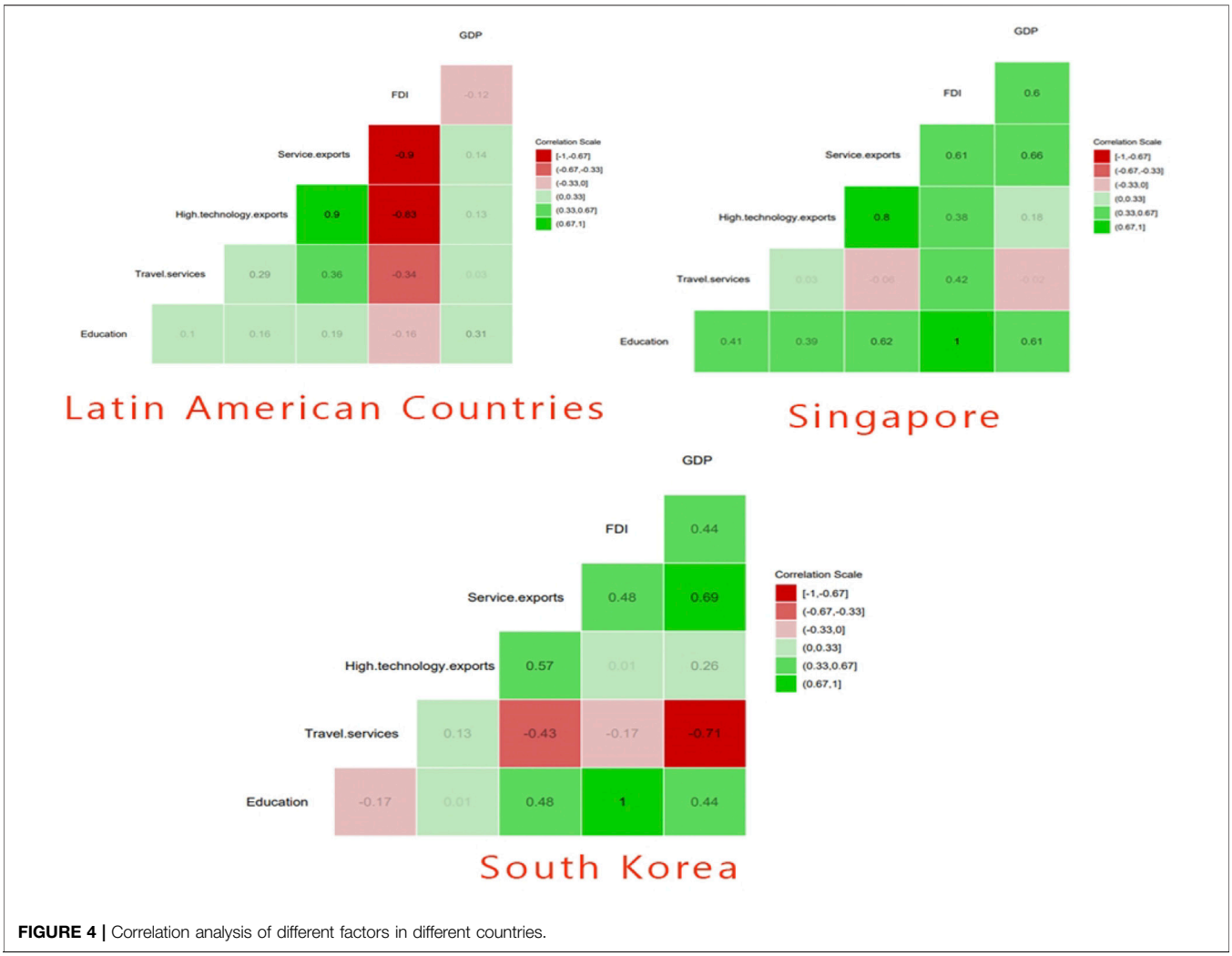

FIGURE 4 | Correlation analysis of different factors in different countries.

The results of the Hausman test found that the fixed effects model was the most suitable for the data in this paper. However, the static panel ignores the dynamic influence of the lag term of the independent variable on itself, which may lead to large deviations in the estimation results. Since the economic growth of the previous period has an impact on the economic growth of the current period, it is necessary to introduce the lag term of economic growth to reflect the dynamic lag effect. On the basis of the static panel model, the first-order lag term of the dependent variable is incorporated into the model to obtain the dynamic panel model as follows:

$$In(y_{it}) = c_0 + \alpha_i + c_1 ln(tec_{it}) + c_2 ln(free_{it}) + c_3 inf_{it} + c_4 ln(open_{it}) + c_5 ln(lab_{it}) + c_6 ln(con_{it}) + c_7 ln(inv_{it}) + c_8 ln(ind_{it}) + c_9 ln(hon_{it}) + c_{10} ln(ci_{it}) + c_{11} ln(y_{i,t-1}) + \varepsilon_{it} \quad (18)$$

Using the lagged term of the dependent variable as an independent variable will cause endogeneity problems in the regression model. In order to better deal with the correlation and endogeneity between cross-sections, regression analysis was performed on the data. First, by using correlation analysis between different factors highlights that for high income countries such as Singapore the impact of GDP is strongly correlated with FDI (0.6) and education (0.61) while travel/tourism has a weak negative correlation with GDP (−0.02). Exports of services (0.66) and technology (0.8) are highly correlated with GDP, which shows that Singapore's GDP is greatly impacted by trade services. Similarly, results are observed for South Korea where GDP has a strong positive correlation with FDI (0.44); however, services (0.69) and technology (0.57) exports also play a major role in economic development by having a positive correlation. In South Korea, travel/tourism is strongly negatively correlated with GDP, which shows that the impact of the tourism sector needs to be improved to further strengthen the economy. Nevertheless, for Latin American countries, both GDP and FDI (−0.12) have a negative correlation, which is one of the reasons that many of the remaining countries in that region are in the MIT. Another reason is the trade and exports that are weakly correlated with GDP (0.13). These are areas where Latin American countries need to focus on by increasing industrialization. **Figure 4** shows further detailed comparisons of correlation between regions or countries.

TABLE 3 | Regression model for Latin American and other countries.

Country name	Education expenditure	Health expenditure	Travel/Tourism services	High technology exports	Service exports	FDI	R^2
Argentina	−3.864*	1.085	−1.088	−0.353	1.099*	−0.000	0.986***
Belize	0.141	0.468	0.131	−0.020*	−0.226	0.001	0.971***
Bolivia	0.01	−0.702*	−0.031	−0.017	0.511*	0.154	0.998***
Brazil	−0.71	−1.63	−0.147	−0.207	0.357	3.878	0.987***
Colombia	−27.73	0.136	−0.203*	0.042	0.318	28.89	0.991***
Costa Rica	−0.305	−0.253	−0.069*	0.008	0.549*	0.745	0.997***
Dominica	0.154	−0.773***	−0.009	−0.017*	0.909***	0.131	0.990***
Dominican Republic	0.507	−0.661*	−0.047*	0.007	0.686**	-0.657	0.997***
Ecuador	0.997	−1.972	0.038	0.209	2.006	0.412	0.999*
Grenada	0.111	−0.957***	0.003	0.000	1.213***	0.131	0.994***
Guatemala	−0.159	−3.230	0.043	0.001	2.522*	0.645	0.988***
Guyana	1.785	−2.708	0.00	−0.044	10.063	0.230	0.996
Honduras	0.141	−0.748**	−0.161*	0.020	0.387	0.211	0.981***
Jamaica	0.530	0.196	−0.115	−0.005	0.048	−0.236	0.992***
S.Korea, Rep	0.512	−2.281***	−0.057*	0.062	1.481***	0.171	0.990***
St. Lucia	−0.106	−1.621	−0.009	0.015	1.421	−0.494	0.997
Mexico	1.395	0.243	0.012	0.015	−0.856***	−3.404*	0.995***
Nicaragua	0.155	−0.603	−0.034	−0.009	0.815***	0.214	0.994***
Panama	0.154	−0.755*	−0.030*	0.009	0.930***	0.131	0.997***
Paraguay	−0.558*	−0.143	0.009	0.127	0.594	0.071	0.997***
Singapore	−1.834	−0.345	−0.030	0.650	0.651	−1.452	0.998
Grenada	−0.862	−0.290	−0.032	−0.066	0.477	−2.439	0.999*
Suriname	0.31	−1.554	−0.000	0.028	1.108	0.211	0.838*
Venezuela, RB	0.112	−5.620**	0.141	0.057	5.571*	0.117	0.960***

, **, *, **** represents the Significance level.*

Next step is to apply regression analysis to further check regression results. **Table 3** shows the regression between different models with the significance between their relationship with the GDP of each country. From **Table 3**, it can be seen that health expenditure has a significant negative impact on Korea (β = −2.281***), Grenada (β = −0.957***), Dominica (β = −0.773***), Venezuela (β = −5.620**and Honduras (β = −0.748**). Observing the developing countries as models for escaping the MIT, their main focus is health expenditure, which is not focused on by many Latin American countries. Similarly, education expenditure has a significant impact on Argentina (β = −3.864*) while other countries show a weak negative relationship with GDP thus not having a major impact on economic growth. High technology exports (trade services) have a positive impact on the GDP in the high-income countries, Korea (β = 0.062) and Singapore (β = 0.65), while Latin American countries show a negative relationship with GDP such as Argentina (β = −0.353), Belize (β = −0.020*), Bolivia (β = −0.017), Jamaica (β = −0.005), Dominica (β = −0.017*), Nicaragua (β = −0.009), Grenada (β = −0.066) and Guyana (β = −0.044). Some Latin American countries have a positive impact on the GDP such as Dominican Republic (β = 0.007), Brazil (β = −0.207), Colombia (β = 0.042), Costa Rica (β = 0.008), Ecuador (β = 0.209), Guatemala (β = 0.001), Honduras (β = 0.02), St. Lucia (β = 0.015), Mexico (β = 0.015), Panama (β = 0.009), Paraguay (β = 0.127), Suriname (β = 0.028) and Venezuela, RB (β = 0.057). Services export have a significant positive impact on the GDP in Korea, Rep. (β = 1.481***) while a similar impact is also observed in some Latin American countries such as Mexico (β = −0.856***), Nicaragua (β = 0.815***), Panama (β = 0.930***), Dominica (β = 0.909***), Bolivia (β = 0.511*), Venezuela, RB (β = 5.571*) and Costa Rica (β = 0.549*) while a weak positive impact is observed in other countries. Travel and tourism has a significant negative impact on Korea (β = −0.057*) while a similar impact is also observed in some countries in Latin America such as Colombia (β = −0.203*), Costa Rica (β = −0.069*), Dominican Republic (β = −0.047*), Honduras (β = −0.161*) and Panama (β = −0.030*). However, FDI has a weak negative impact on the GDP in high-income countries Korea, Rep. (β = −1.352) and Singapore (β = −1.452). Most of the Latin American countries show a positive relationship [Brazil (β = 3.878), Colombia (β = 28.89), Jamaica (β = −0.236) and St. Lucia (β = -0.494)], which is contrary to high-income countries.

After getting significant factors from correlation and regression models next step is to validate results by checking with panel ARDL econometric model. **Table 4** shows the results of long-run estimation using PMG, MG and DFE estimators. The results of the Hausman test to choose either PMG or MG show that it is not significant, and thus PMG is better than MG. The results of the Hausman test for PMG and DFE show that PMG is still preferable as the *p*-value is higher than the significance level. The results of the three estimators (PMG, MG and DFE) in **Table 5** and **Table 5** are elaborated more in detail by keeping GDP as the dependent variable. In **Table 5** using DFE, the relationship of travel services, and FDI is negative while other factors show a positive relationship with GDP. Similarly, using PMG travel services (−1.07), services exports (−2.22) and education (−0.108) show a negative relationship while other show a positive relationship. Similarly for MG the results for FDI and Health is negative on GDP while other factors are creating a positive impact on

TABLE 4 | Panel Data Analysis using MG, DFE, and PMG for high-income Countries.

	Panel high-income countries											
	Mean group estimation (MG)				Dynamic fixed effects (DFE)				Pooled mean group estimation (PMG)			
Parameters	**Coef**	**Std. Err**	**Z**	***p*** **>** **z**	**Coef**	**Std. Err**	**Z**	***p*** **>** **z**	**Coef**	**Std. Err**	**z**	***p*** **>** **z**
Travel service	−1.93E + 10	1.93E + 10	−1.00E + 00	3.17E−01	−5.13E+09	1.15E+10	−4.50E−01	6.54E−01	−1.07E+00	4.51E−01	−2.00E−01	8.41E−01
Services exports	−3.55E + 00	2.04E + 00	−1.74E + 00	8.20E−02	2.50E−01	1.59E+00	1.60E−01	8.75E−01	−2.22E+00	2.67E+00	−1.10E−01	9.12E−01
FDI	−6.24E−01	2.21E + 00	−2.80E−01	7.78E−01	−5.81E−01	1.16E+00	−5.00E−01	6.16E−01	1.39E+00	1.57E+00	−1.90E−01	8.49E−01
High technology exports	4.14E + 00	2.18E + 00	1.90E + 00	5.80E−02	9.65E−01	8.93E−01	1.08E+00	2.80E−01	4.26E+00	3.77E+00	−1.80E−01	8.57E−01
Education	1.85E−01	3.71E−01	−3.20E−01	7.46E−01	7.40E−01	2.07E−01	3.58E+00	0.00E+00	−1.08E−01	3.96E−01	1.83E+00	6.70E−02
Health	−3.59E−02	1.11E−01	9.50E−01	3.43E−01	−2.51E−01	1.38E−01	3.08E+00	2.00E−03	6.05E−02	9.48E−02	1.15E+00	2.49E−01
Error correction estimation	2.05E−02	5.43E−02	3.80E−01	7.05E−01	−1.28E−01	1.79E−01	−7.10E−01	4.76E−01	3.99E−02	8.78E−02	−2.00E−01	8.44E−01

TABLE 5 | Panel Data Analysis using MG, DFE, and PMG for Latin American Countries.

	Panel B (Latin American countries)											
	Mean group estimation (MG)				Dynamic fixed effects (DFE)				Pooled mean group estimation (PMG)			
Parameters	**Coef**	**Std. Err**	**Z**	***p*** **>** **z**	**Coef**	**Std. Err**	**z**	***p*** **>** **z**	**Coef**	**Std. Err**	**z**	***p*** **>** **z**
Travel Service	−1.44E + 10	1.44E + 10	−1.00E + 00	3.17E−01	−5.81E + 09	1.07E + 10	−5.40E−01	5.88E−01	−1.07E + 00	4.51E−01	−2.36E + 00	1.80E−02
Services exports	−2.34E + 00	1.88E + 00	−1.24E + 00	2.14E−01	2.20E−01	1.42E + 00	1.50E−01	8.77E−01	−2.22E + 00	2.67E + 00	−8.30E−01	4.07E−01
FDI	−5.51E−01	1.57E + 00	−3.50E−01	7.25E−01	−5.04E−01	9.99E−01	−5.00E−01	6.14E−01	8.42E + 00	9.65E−01	8.90E−01	3.75E−01
High technology exports	3.03E + 00	1.90E + 00	1.60E + 00	1.10E−01	2.12E + 09	6.10E + 08	1.23E + 00	2.20E−01	1.81E−01	7.40E−01	1.13E + 00	2.59E−01
Education	9.53E + 08	9.53E + 08	1.64E + 00	1.02E−01	7.59E−01	1.75E−01	4.34E + 00	0.00E + 00	1.62E−01	−2.51E−01	6.40E−01	5.23E−01
Health	1.64E−01	2.63E−01	1.00E + 00	3.17E−01	7.59E−01	1.75E−01	−2.20E + 00	2.80E−02	1.27E−01	−1.28E−01	1.40E−01	8.86E−01
Error correction estimation	−6.16E−02	9.06E−02	−6.80E−01	4.97E−01	−1.25E−01	1.53E−01	−8.20E−01	4.15E−01	3.99E−02	8.78E−02	4.50E−01	6.50E−01

GDP. For Latin American countries using DFE, travel services and FDI producing the negative impact while other factors are having positive impact on GDP, For PMG model results for FDI are positive for GDP, while travel services and other factors are creating negative relationship. Using MG model, the travel services, services exports, FDI are having negative impact on GDP.

Our main findings can be summarised as follows: 1) there is a negative effect of the public debt ratio on economic growth, both in the short-run and long-run, 2) the negative relationship is more significant when we use common correlated factors to address the issue of cross-sectional dependence, 3) an asymmetric response of a change in public debt is found to be significantly negative in the short-run. As such, rises in short-run public debt negatively affect economic growth in the short-run but falls public debt do not have a correspondingly positive effect on economic growth in the short-run.

Kuchiki et al. (2017) highlights the same factors as our research, i.e., tourism and service exports are important components in avoiding the MIT and growing industrialization. Developing countries purchase relatively modern technical equipment from developed countries and introduce comparatively advanced management concepts to develop their somewhat backward industries, improve capital accumulation, and improve technical efficiency. However, once a country develops to a certain stage, new difficulties will appear, such as the establishment of technical barriers by advanced countries, the formulation of trade barriers, the implementation of intellectual property protection, and the change of world trade rules and regulations. Sim and Ali (1998) agree with our study, which shows that trade is important and export-oriented economies can improve production technology by imitating foreign products in the early stages. Therefore, the improvement of the R&D capabilities of enterprises and the core competitiveness of products will help them in a smooth transition. Judging from indicators such as the proportion of R&D investment in each country and the number of scientific researchers, countries such as Japan, South Korea, and Singapore have successfully broken through the MIT by having higher economic and social benefits from R&D investment, while Brazil, Mexico, and other Latin American countries are trapped due to the contribution of low scientific research for economic development within the MIT countries (Lall, 2000). The study of Dahlman et al. (1987) shows that FDI and industrialization for labor growth plays an important role in a country's development. Therefore, these countries stay in a low-end position for a long time when participating in global trade and are unable to achieve sustained and stable economic growth across the middle-income quagmire. Due to the lack of core competitiveness, the ability of low- and middle-income countries to take risks is relatively low. In the face of external risks such as short-term economic downturn, technological monopoly, and the rewriting of trade rules in developed countries, the domestic economy is turbulent, and accumulated political and social conflicts erupt (Austin, 2002). On the other hand, our results compare with Mahul et al., who highlight that the labor force and new local products are important factors for avoiding the MIT. The MIT shows that countries that rely on low value-added and high-polluting low-end products have the risk of an internal industrial structure transformation, and the external risk of increasing the division of labor in the global value chain (Mahul and Stutley, 2010).

Some countries in Latin America and Africa as well as other countries caught in the MIT have a relatively single export structure, a high proportion of low value-added primary product exports, and limited export targets (Clarke et al., 2003) (Agosin and Bravo-Ortega, 2009). Our study highlights the similar fact that the trade component is avoided in these countries. The uncertainty of the world economy and the economic instability of exporting countries will cause price fluctuations of the export products of these countries. During the downturn of the world economy, since there is no bargaining power, the foreign exchange earnings of low- and middle-income countries will be greatly weakened, and the fragile domestic economic system will definitely be implicated (Sabel et al., 2012). Such a vicious circle will cause these countries to be unable to upgrade their industrial structures and to be at the lower end of the globalized division of the labor system, thus preventing them from entering the ranks of high-income countries. For developing countries, foreign trade is an important factor in promoting economic growth. Basically, it is necessary to develop foreign trade with comparative advantages based on the national conditions of the country (Fahim et al., 2021). It is necessary to speed up the transformation of the industrial structure, vigorously develop tertiary industry, and accelerate the change of industrial focus. In the process of developing tertiary industry, the importance of secondary industry cannot be ignored. Secondary industry is still an important sector for creating social wealth and stabilizing economic growth (Besedes and Blyde, 2010).

3.1 Policy Recommendations

This study is significant for middle-income countries by focusing on different factors which can help in avoiding the MIT. A few suggestions and policy recommendations for stockholders and government are:

3.1.1 Strengthen Exports

This can be done by managing capital goods and attaching importance to the export of high-tech products. The content of capital goods is great, and its export price plays an important role in regulating the development of a country's foreign trade. It not only intuitively reflects the laws of internal industrial production, but also acutely reflects changes in the external economy. There-fore, only by strengthening reform of the capital goods export management system can economic and technological value be exerted more effectively, and greater wealth can be created. In addition, capital goods with high technology content are even more critical in current international competition. The development of economic globalization has promoted the development of the diversification of global trade. There are increasingly more trade exchanges between countries, which promote the development of world trade towards a virtuous circle and accelerate the flow of world factor resources. The research and development, production and sales of high-tech products has become a worldwide industry. High-tech products, as a means of further strengthening the competition of a country's foreign trade in capital goods, are rising in status in today's international trade. In the current world situation, developing countries such as China, which are on the disadvantaged side of

scientific and technological resources, while exerting their comparative advantages of the "catch-up effect", absorb the advanced scientific research achievements of developed countries, improve scientific literacy, increase production skills, and cultivate independent innovation capabilities, using the limited resources of the country to harvest greater output and optimize the industrial structure.

3.1.2 Consumer Goods and Industrialization

In the world market, highly competitive industrial products are mainly concentrated in labor-intensive items such as textiles, toys, and consumer goods. These products have low added value and short product chains, which are not conducive to China's competitive advantage in the international market. The export growth of consumer electronics and electrical appliances in recent years shows that China is making great efforts to improve the added value and foreign exchange earning capacity of traded products, and to participate more actively in the division of labor in the global value chain. The current global trade pattern is undergoing profound changes; on the one hand, European and American countries have implemented the strategy of "industrialization" to seize the commanding heights of international trade; on the other hand, emerging economies such as India and Vietnam have used their comparative ad-vantages in labor prices to accelerate the process of industrialization. From the perspective of long-term development, China's export of consumer goods must find a new development path, reshape new advantages in international competition, realize industrial upgrading, and become a "manufacturing power."

3.1.3 Foreign Direct Investment Involvement for Quality Products

The employment population and trade activities involved in processing trade are highly considerable. Therefore, while stabilizing the advantages of traditional processing trade, countries should enhance the innovation ability of processing trade, cultivate new advantages in processing trade, change the original pattern of relying solely on abundant labor to obtain comparative advantages, allowing enterprises to better participate in the global division of labor, and improving the awareness of independent R&D. Foreign direct investment can help in improving the quality of labor by R&D and continuous training in the latest methods. The production of high-end industrial products is of great significance to the promotion of China's trade status and the realization of sustainable economic development.

4 CONCLUSION

This study compares and analyzes different criteria for determining the MIT in Latin American countries and provides possible reasons for the MIT. Our research finds that the social and economic development of Latin American MIT countries contains some com-mon characteristics, and the findings help us understand the mechanism of the "middle-income trap." In South Korea and Singapore, through an analysis of the proportion of trade exports of various types of export commodities, a reasonable explanation for the difference in the export commodity structure between "middle-income trap" and non-"middle-income trap" countries is obtained. For non-"middle-income trap" countries, the industrial upgrading process seems to be consistent with the flying geese pattern of development. It follows that industrial upgrading through backward linkages between consumer goods and capital goods is more successful in high-income countries that are not in MITs. For countries that are in MITs, there is a tendency to rely on exports of primary products, while industrialization is driven by forward linkages of finished products. A weak industrial base is a possible factor in the MIT. These analyses can describe the MIT. The policy implications of the findings of this study are very direct. It is necessary to develop the consumer goods industry and maintain competitiveness in promoting the up-grading of industries to capital goods through backward linkages. Although there are many problems in the economic development of Latin America, these difficulties can be improved through economic and social policies. Based on the reasons analyzed above, Latin American governments can implement the following policies:

- Raise the national education level and train workers with advanced technology.
- Increase scientific research funding and encourage R&D innovation.
- Promote industrial upgrading.
- Create a favourable environment for foreign investment and encourage overseas in-vestment to stimulate the economy.
- Improve the role of taxation; allow taxation to facilitate the reduction of the gap be-tween the rich and the poor and increased social welfare.

Future work of this study is to increase the variables and find in more dept relationship to improve the economic growth substantially.

DATA AVAILABILITY STATEMENT

The datasets presented in this study can be found in online repositories. The names of the repository/repositories and accession number(s) can be found at N/A.

AUTHOR CONTRIBUTIONS

Data curation, LG, DA and CC; Formal analysis, LG and SS; Methodology LG, CC, and SS; Software, LG and SS, Writing—original draft, LG.

FUNDING

This study was funded by funds from Corporación universitaria Americana.

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