



The Impact of Free Zones on Foreign Direct Investment: Evidence from Nine Developing Countries

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Abstract

This study examines the relationship between free zones and foreign direct investment (FDI) in a sample of nine developing countries—Cambodia, Colombia, India, Indonesia, Malaysia, Tanzania, Thailand, the United Arab Emirates, and Vietnam—over the period 2000–2024. Due to the lag structure of the Panel ARDL model, the effective estimation window is 2003–2024. The study aims to evaluate the relationship between free-zone development and FDI by distinguishing between short-run and long-run effects. To address the lack of a standardized indicator for measuring free-zone development, the study develops a quantitative indicator based on the cumulative area of free zones, using information on their establishment dates and spatial expansion over time. The study employs the Panel Autoregressive Distributed Lag (Panel ARDL) model with the Pooled Mean Group (PMG) estimator to examine the dynamic relationship between free zones and FDI. Unit root and Johansen–Fisher panel cointegration tests are used to assess the time-series properties of the variables and the existence of a long-run equilibrium relationship. The empirical findings indicate a positive and statistically significant long-run association between cumulative free-zone area and FDI stock, while the short-run association is not statistically significant. The results also show positive and statistically significant long-run associations between government spending, labor force participation, and urbanization with FDI stock, whereas only changes in government spending are statistically significant in the short run. Overall, the findings indicate that the relationship between free-zone development and FDI stock becomes more evident over the longer adjustment period.

Keywords: *Free Zones, Foreign Direct Investment (FDI), Panel ARDL, Pooled Mean Group (PMG), Investment Attraction*

INTRODUCTION

The concept of free zones has evolved considerably over time in terms of their objectives, functions, locations, and geographical size. Given the ambiguity surrounding the concept and the limited number of studies that have examined it comprehensively, understanding free zones helps clarify the nature of investment and economic activities within them. Initially, free zones were established primarily as locations for storage and re-export activities. However, over time, they developed into integrated areas providing various services in manufacturing, exports, trade, and other economic activities. In terms of location, free zones were initially established mainly along major international trade routes and in relatively limited areas; however, they are now established in different parts of countries, including remote areas, to stimulate economic and urban development and attract population and investment. A free zone can generally be defined as a geographically defined and enclosed area with designated entry and exit points where investors undertake specific economic activities, making these zones an important component of the commercial and economic activity of host countries (Hamid, 2023). Free zones are considered among the important instruments adopted by countries to enhance economic activity, as they contribute effectively to attracting foreign direct investment, thereby supporting economic growth.

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They may be defined as designated areas within a host country's territory that, for foreign trade purposes, are treated as outside the customs territory. These zones offer investors broad opportunities to engage in commercial activities, including importing, exporting, storage, processing, manufacturing, and service provision, while being exempt, wholly or partially, from the restrictions and taxes applicable within the customs territory (AL-Harazi, 2007). From a legal perspective, free zones are areas located outside the territory, where national laws and regulations governing production, trade, and other economic activities may be wholly or partially exempted. Public authorities, private entities, or public-private partnerships may manage these zones (Eneh et al., 2024). The Revised Kyoto Convention emphasized the importance of a clearly defined and regulated geographical area in its definition of free zones. According to the Convention, a free zone is a part of the territory of a Contracting Party where goods introduced are generally regarded, insofar as import duties and taxes are concerned, as being outside the customs territory. Accordingly, goods entering free zones receive special customs treatment with respect to import duties and taxes (World Customs Organization [WCO], 2020). The United Nations Conference on Trade and Development (UNCTAD), in its classification of free zones, defined them as essentially separate customs territories. Beyond relief from duties and tariffs, most zones also offer fiscal incentives and business-friendly regulations on land access, permits and licenses, employment rules, and administrative streamlining and facilitation. Therefore, free zones extend beyond customs exemptions to include a broader set of fiscal, regulatory, and administrative incentives designed to facilitate investment and economic activity (Alansary & Al-Ansari, 2023). In recent decades, Free Trade Zones and Special Economic Zones have become an important component of the outward-oriented policies adopted by many developing countries. Several factors explain this growing trend. First, host countries consider free zones an important instrument for attracting foreign direct investment, increasing manufactured exports, and supporting long-term economic diversification and growth. Second, in countries with high unemployment, these zones are seen as an effective way to create jobs and reduce unemployment at both regional and national levels. Third, although often implicit, establishing free zones can provide a gradual pathway toward economic reforms and serve as a more acceptable alternative to comprehensive economic liberalization, which may be harder to implement in both practical and political terms (Hakimian, 2011). Amid growing international uncertainty and a slowing global economy, countries worldwide have increasingly sought new policies and mechanisms to stimulate economic recovery and promote economic activity. Capital is a key factor in economic expansion, while foreign direct investment (FDI) is an important source of external financing. FDI plays a significant role in easing domestic financing constraints, facilitating technological progress and knowledge transfer, and supporting economic growth and development across countries and regions (Zhang & Wang, 2023). In recent years, China's FDI inflows have fluctuated relatively little; however, the growth rate has remained slow, with negative growth in some years, including -3.74% in 2012 and -0.21% in 2016. To strengthen its ability to attract FDI, China adopted the Free Trade Zone (FTZ) strategy, which aims to facilitate and liberalize foreign investment through improvements in administrative and management systems, infrastructure development, stronger cooperation between domestic and foreign investment, and the implementation of innovative policies and institutional measures (Zhang & Wang, 2023). Under this strategy, China established 21 pilot FTZs in different phases, contributing to the gradual expansion and geographical distribution of these zones. The innovative policies and institutional measures implemented within the pilot FTZs have improved the facilitation and liberalization of FDI, thereby affecting FDI inflows within the zones and potentially extending their influence to surrounding areas through spatial spillover effects (Zhang & Wang, 2023). Beyond their direct contribution to attracting investment and stimulating trade, free zones may also contribute to broader economic and regional development through improvements in

employment opportunities, infrastructure, market accessibility, and the movement of economic resources. Economic mobility refers to the capacity of individuals, households, and communities to improve their economic conditions and achieve better economic opportunities over time. Enhancing economic mobility between urban and rural areas is important for reducing regional inequalities, promoting social inclusion, and supporting sustainable economic development. It depends largely on the movement and accessibility of labor, capital, knowledge, resources, and economic opportunities across different geographical areas. Differences in employment opportunities, income levels, infrastructure, and market access can influence the movement of people and economic resources between urban and rural regions. Therefore, achieving more balanced economic mobility requires improving connectivity, strengthening infrastructure, and implementing supportive policies that encourage investment, entrepreneurship, and economic activity in both urban and rural areas (Hasddin et al., 2025). Based on the foregoing discussion, free zones can be defined as geographically designated and regulated areas within the territory of a country that operate under a special customs, fiscal, and regulatory regime that differs, wholly or partially, from the regime applicable to the rest of the customs territory. These areas provide investors with a range of customs, fiscal, administrative, and regulatory incentives intended to facilitate trade, attract foreign direct investment, promote exports, encourage industrial and service activities, create employment opportunities, and support economic diversification and economic development. Accordingly, free zones have evolved from relatively simple storage and re-export locations into broader economic instruments that are an important component of national strategies for investment attraction, trade facilitation, industrial development, and economic growth.

Despite the growing use of free zones as instruments for investment promotion and economic development, empirical evidence on their relationship with foreign direct investment remains mixed, particularly across developing countries. Previous studies have largely focused on individual countries, specific types of free and special economic zones, or particular dimensions of zone performance, limiting cross-country comparability. In addition, many studies have relied on the presence or count of zones rather than a quantitative measure that captures the physical scale and cumulative development of free-zone space over time. Relatively little attention has also been given to distinguishing between the short-run and long-run relationship between free-zone development and FDI. These limitations make it difficult to assess whether the expansion of free zones is associated with sustained FDI accumulation over time. This study addresses these gaps by developing a quantitative indicator based on the cumulative area of free zones and applying it to a panel of nine developing countries over the period 2000–2024, with an effective econometric estimation window of 2003–2024.

Accordingly, this study aims to construct a quantitative indicator to measure free-zone development and to examine its relationship with foreign direct investment. Using the Panel ARDL framework, the study distinguishes between short-run and long-run relationships and examines whether the association between cumulative free-zone area and FDI stock varies across adjustment periods. By focusing on nine developing countries, the study provides a quantitative, dynamic assessment of how the scale of free-zone development relates to FDI accumulation over time. The study also contributes to the literature by linking the physical scale of free-zone development to the dynamic process of FDI accumulation while explicitly distinguishing between short-run and long-run associations.

LITERATURE REVIEW

Mechanisms of Free Zone Operation

The operation of free zones can be understood through several key mechanisms, particularly their territorial status, the involvement of customs authorities, and the regulatory measures adopted to prevent their misuse for illicit activities. These mechanisms determine how free zones function within the national customs system and how the objectives of trade facilitation and investment promotion can be balanced with effective regulatory oversight.

Territoriality Aspect of Free Zones

The determination of the territorial status of free zones is one of the main legal mechanisms governing their operation. It defines the relationship between the free zone and the host country's customs territory and is therefore important for determining the scope of customs procedures and controls applicable within these zones. The way a free zone is legally defined directly affects the application of customs procedures and the role of customs authorities in supervising goods and activities within the zone. According to the World Customs Organization (WCO), the definition of a free zone under the Revised Kyoto Convention does not mean that the zone is geographically located outside the customs territory. Rather, it constitutes part of the customs territory, while goods introduced into the zone are generally treated, for the purposes of import duties and taxes, as if they were outside the customs territory. Therefore, the special customs status of free zones should be understood as a special customs treatment rather than as complete geographical separation from the territory of the host country ([World Customs Organization \[WCO\], 2020](#), p. 23).

Full Customs Involvement in Free Zones

The involvement of customs authorities is another important mechanism for the effective operation and regulation of free zones. The World Customs Organization emphasizes the importance of customs participation in the establishment and management of free zones, including examining applications to establish new zones, determining the goods and activities permitted within them, approving companies operating in the zones, and verifying compliance with the relevant requirements before operations commence. The involvement of customs authorities is particularly important because customs administrations possess specific powers and expertise related to the inspection and control of goods entering, leaving, and moving through free zones. Consequently, customs authorities should be involved not only in controlling goods after a free zone has been established, but also in the formulation of national free zone policies, the establishment of new zones, and the approval of companies and activities operating within them. Such involvement helps maintain an appropriate balance among trade facilitation, investment promotion, and effective customs control ([WCO, 2020](#), p. 26).

International Recognition of Free Zones in Combating Illicit Trade

The operation of free zones is also associated with the need to prevent their potential misuse for illicit trade and other unlawful activities. International experience underscores the importance of effective regulatory and monitoring mechanisms within these zones. The United Nations Convention against Illicit Traffic in Narcotic Drugs and Psychotropic Substances of 1988 explicitly addressed free trade zones and free ports, requiring States Parties to apply measures to suppress illicit traffic in such areas that are no less stringent than those applied in other parts of their territories. This provision reflects the importance of ensuring that the special customs treatment granted to free zones does not result in weaker controls over illicit activities ([United Nations, 1988](#)).

International efforts to regulate illicit activities in free zones have also advanced through the

Protocol to Eliminate Illicit Trade in Tobacco Products. The Protocol, which entered into force in 2018, includes specific provisions on free zones and requires Parties to implement effective controls over the manufacture of and transactions in tobacco and tobacco products within free zones. These developments reflect growing international recognition of the need to align the trade and investment facilitation functions of free zones with appropriate regulatory and customs controls ([World Health Organization \[WHO\], 2013](#)).

Accordingly, the effective operation of free zones requires a balance between facilitating legitimate trade and investment and maintaining appropriate regulatory oversight. Clear territorial arrangements, effective customs participation, and adequate measures to prevent illicit activities are important mechanisms that enable free zones to operate efficiently while supporting their broader economic objectives.

[Zeng \(2015\)](#) examined global experiences with Special Economic Zones (SEZs), with particular emphasis on China and African countries. The study was motivated by the considerable variation in SEZ implementation outcomes across countries. While countries such as China, Singapore, Malaysia, the Republic of Korea, Jordan, and Mauritius achieved relatively successful outcomes and positive economic results, many other countries, particularly in Sub-Saharan Africa, continued to face significant challenges in developing and operating SEZs.

The study aimed to provide a brief overview of Special Economic Zones, analyze the experiences of implementing these zones in China and in African countries, and identify the main lessons that African countries could learn from China's experience. It also examined the more recent experience of Chinese economic zones established in Africa. To achieve these objectives, the study adopted a comparative analytical approach, comparing the experiences of SEZs in China with those in African countries to identify the factors that contributed to their success or failure.

The findings showed that Special Economic Zones have attracted growing global attention as an important instrument for supporting economic growth, attracting investment, promoting exports, and facilitating industrial development. However, the varied outcomes across countries demonstrate that SEZs are not a universal solution for economic development. Their effectiveness depends largely on careful policy design and implementation, as well as their compatibility with each country's economic and institutional characteristics. The study emphasized the importance of appropriate institutional frameworks, effective government policies, adequate infrastructure, and investment incentives in determining the success or failure of these zones ([Zeng, 2015](#)).

[Hsu et al. \(2021\)](#) examined the performance of Free Trade Port Zones in attracting foreign direct investment. The study developed an evaluation model using the Fuzzy Analytic Hierarchy Process (Fuzzy AHP) to identify the factors influencing foreign investors' decisions. The findings showed that governmental and economic factors were among the most important determinants of investment attractiveness, followed by operating costs. Access to raw materials, political stability and social security, local government efficiency, and tax incentives were identified as important factors for enhancing the attractiveness of Free Trade Port Zones to foreign investors.

[Yuan \(2023\)](#) investigated whether the establishment of Free Trade Zones improves the quality of foreign direct investment utilization in China. Using data from 31 regions during 2013–2019, the study employed Propensity Score Matching and a multi-period Difference-in-Differences model to estimate the policy effect. The results indicated that the establishment of Free Trade Zones improved the quality of FDI utilization, particularly by strengthening technological spillover effects. Robustness tests confirmed the stability of the findings, highlighting the importance of institutional innovation and the further development of FTZs in attracting higher-quality foreign investment.

[Wang \(2013\)](#) emphasized the importance of capital and advanced technology for economic development and treated Special Economic Zones as place-based policies designed to attract foreign capital, promote exports, and facilitate the adoption of advanced technologies. The study

examined the effects of SEZs on local economic outcomes, particularly investment, total factor productivity growth, and factor prices, suggesting that the benefits of SEZs may extend beyond attracting foreign investment to improving productivity and the broader performance of local economies.

Employment is also an important channel through which investment and economic activity can influence economic development. [Sumarsono \(2003\)](#) indicated that employment is influenced by several economic factors, particularly national income, investment, and wage rates. Changes in these factors can consequently affect employment levels and the availability of job opportunities. The creation of employment opportunities also enables individuals to generate income, meet their basic needs, and improve their economic well-being.

From a theoretical perspective, labor demand is closely tied to labor's contribution to the production of goods and services. Therefore, labor demand is largely determined by the volume and level of production. As production expands and economic activity increases, the demand for labor is expected to rise, leading to greater income generation. Accordingly, Gross Domestic Product (GDP) can serve as an indicator of income and overall economic activity ([Simanjuntak, 1998](#); [Sitompul & Simangunsong, 2019](#)).

The Neoclassical Growth Theory, particularly the Solow-Swan Growth Model, explains economic growth through the interaction of labor, capital, and technological progress. GDP is an important indicator of economic performance because it measures the total value of goods and services produced within a country's geographical boundaries over a given period. Accordingly, capital accumulation, labor utilization, technological progress, and economic activity are closely interconnected in determining economic growth ([Arman, 2023](#)).

Overall, the reviewed literature indicates that Special Economic Zones and Free Trade Zones can influence economic development through several interconnected channels, particularly by attracting FDI, improving the quality of foreign investment, facilitating technological spillovers, increasing productivity, and generating employment. Nevertheless, the magnitude of these effects varies across countries and depends on institutional conditions, infrastructure, government policies, and the investment environment. Therefore, further empirical investigation is needed to examine the role of Free Zones in attracting FDI, particularly in developing countries ([Zeng, 2015](#); [Hsu et al., 2021](#); [Yuan, 2023](#)).

Overall, the reviewed studies indicate that free zones can provide an institutional and economic environment that supports investment by facilitating trade, reducing transaction costs, improving access to infrastructure, and offering regulatory or fiscal incentives. However, the evidence is not uniform across countries and studies. Some studies emphasize the positive role of free zones in attracting investment and supporting economic activity, whereas others highlight that their effectiveness depends on the institutional environment, infrastructure quality, governance arrangements, and the extent to which zones are integrated into the broader economy. Differences in country characteristics, free-zone design, data availability, and empirical approaches may therefore contribute to differences in reported outcomes. A further limitation of the existing literature is the difficulty of quantitatively measuring the development and scale of free zones in a way that is comparable across countries and over time. The number of zones alone does not necessarily capture their physical scale or expansion. Moreover, studies that examine the relationship between free zones and FDI have paid relatively limited attention to whether the relationship differs between the short run and the long run. The present study responds to these unresolved issues by using cumulative free-zone area as a quantitative indicator of free-zone development and by employing a dynamic panel framework to distinguish short-run from long-run relationships with FDI. Conceptually, the relationship can be understood through several channels. Free zones may provide investment incentives, customs facilitation, infrastructure, and a more

specialized regulatory environment. These mechanisms can improve the investment conditions faced by firms and may therefore be associated with greater FDI attraction and accumulation. The expected relationship is consequently positive, although its magnitude and timing may differ across countries and over time.

RESEARCH METHOD

Despite the growing use of free zones as instruments for investment promotion and economic development, empirical evidence on their relationship with foreign direct investment remains mixed, particularly across developing countries. Previous studies have largely focused on individual countries, specific types of free and special economic zones, or particular dimensions of zone performance, limiting cross-country comparability. In addition, many studies have relied on the presence or count of zones rather than a quantitative measure that captures the physical scale and cumulative development of free-zone space over time. Relatively little attention has also been given to distinguishing between the short-run and long-run relationship between free-zone development and FDI. These limitations make it difficult to assess whether the expansion of free zones is associated with sustained FDI accumulation over time. This study addresses these gaps by constructing a quantitative free-zone indicator based on cumulative free-zone area and applying it to a panel of nine developing countries during the study period 2000–2024, with an effective econometric estimation window of 2003–2024.

Accordingly, this study aims to construct a quantitative indicator to measure free-zone development and to examine its relationship with foreign direct investment. Using the Panel ARDL framework, the study distinguishes between short-run and long-run relationships and examines whether the association between the cumulative area of free zones and FDI stock varies across adjustment periods. By focusing on nine developing countries from 2000 to 2024, the study provides a quantitative and dynamic assessment of the relationship between the scale of free-zone development and FDI.

Data Collection and Free-Zone Area Indicator

The free-zone area variable was constructed by the researcher using official and institutional sources documenting the establishment, expansion, and development of free zones in the selected countries. Data were collected from free-zone authorities, government agencies, investment promotion agencies, customs authorities, official government reports, and other reliable institutional publications. Where available, information on the establishment year and the geographical area of each free zone was identified and cross-checked across sources.

The free-zone area indicator was measured in square meters (m²) and constructed annually for the period 2000–2024. The indicator reflects the cumulative documented area of free zones over time, based on information on establishment and expansion reported in the underlying sources. This approach was adopted because comparable annual data on FDI specifically attributable to free zones are not consistently available across the selected countries, and the number of free zones alone does not adequately capture their geographical scale or capacity.

To improve data reliability, information from different sources was compared and reconciled when discrepancies arose. Priority was given to official sources and those that provided explicit information on the establishment date, geographical area, or expansion of individual free zones. The final dataset was prepared by the researcher using 198 sources across the selected countries.

The selection of countries in the study was primarily constrained by data availability. The final sample consists of nine developing countries—Cambodia, Colombia, India, Indonesia, Malaysia, Tanzania, Thailand, the United Arab Emirates, and Vietnam—for which the researcher obtained sufficiently consistent data on free-zone area over the study period, along with the

macroeconomic variables required for the empirical model. Accordingly, the selected countries were included to ensure the feasibility and consistency of the panel dataset and the construction of the free-zone indicator over 2000–2024. This selection criterion reflects data availability and comparability rather than an assumption that the selected countries are fully representative of all developing countries.

Table 1 presents the cumulative free-zone area, measured in square meters, for the nine developing countries during the study period 2000–2024. The variable was constructed by accumulating the documented free-zone area over time for each country, based on information on the establishment, expansion, and development of individual free zones. This approach allows the indicator to reflect changes in the geographical scale of free-zone development across countries and over time. The cumulative measure was selected to provide a quantitative representation of the spatial extent of free zones, rather than relying solely on the number of zones established in each country. The table therefore provides the underlying free-zone-area data used to construct the LNFZ variable employed in the empirical model and serves as a descriptive representation of the development of free-zone space throughout the study period.

Table 1. Cumulative areas of free zones as the main independent variable in the study model

Year/ Country	Cambodia	Colombia	India	Indonesia	Malaysia	United Republic of Tanzania	Thailand	United Arab Emirates	Vietnam
2000		7542000	10278984. 76	39400000 0	602290386 .7	38213000	116100800	104806379	4250000
2001		7542000	10278984. 76	39400000 0	602290386 .7	38213000	116100800	104853884 .3	4250000
2002	1500000	7542000	10278984. 76	39400000 0	602300386 .7	38213000	116100800	131799943 .6	6280000
2003	1500000	7542000	21365984. 76	39400000 0	602300386 .7	38213000	116100800	139789601 .6	27628000 0
2004	1500000	7542000	21365984. 76	39400000 0	606501226 .7	38213000	116100800	793089601 .6	27628000 0
2005	1500000	7542000	21365984. 76	39400000 0	606501226 .7	38213000	116100800	796089604 .4	84628000 0
2006	48740000	7792000	89944230	39400000 0	606501226 .7	79763456. 4	116100800	149708960 4	30312900 00
2007	58725600	9784000	122831414 .6	11126744 80	606501226 .7	79763456. 4	116100800	151213960 4	38312900 00
2008	91865200	1137260 0	123410394 .6	11126744 80	606501226 .7	109763456 .4	116100800	151253960 4	43639900 00
2009	96122800	1336320 0	123410394 .6	11126744 80	606501226 .7	110363456 .4	116100800	151253960 4	43639900 00
2010	11877280 0	2233472 0	123410394 .6	11126744 80	606501226 .7	110363456 .4	116100800	165253960 4	44739900 00

2011	11877280 0	2233472 0	123410394 .6	11126744 80	606501226 .7	110363456 .4	116100800	220253960 4	44739900 00
2012	12328980 0	2233472 0	123410394 .6	11477021 80	606501226 .7	110363456 .4	116100800	229053960 4	44739900 00
2013	13031400 0	2263472 0	123410394 .6	11477021 80	606501226 .7	110363456 .4	116100800	229053960 4	50632200 00
2014	13425880 0	2383472 0	123410394 .6	11863831 80	606501226 .7	110363456 .4	116100800	229053960 4	50632200 00
2015	13425880 0	2383472 0	123410394 .6	11863831 80	606501226 .7	110363456 .4	287910080 0	229053960 4	50632200 00
2016	14930900 0	2383472 0	123410394 .6	11948641 80	606501226 .7	123993456 .4	464293080 0	229053960 4	50632200 00
2017	15042110 0	2383472 0	123830180 .3	12444249 80	320650122 7	123993456 .4	179193308 00	232379041 0	57232200 00
2018	15097110 0	2421472 0	123839470 .6	12444249 80	320650122 7	123993456 .4	179193308 00	232379041 0	57232200 00
2019	15376420 0	2421472 0	123839470 .6	12676279 80	321048182 7	123993456 .4	179193308 00	232379041 0	63050200 00
2020	17151830 0	2421472 0	123839470 .6	12676279 80	321048182 7	123993456 .4	179193308 00	232399041 0	63050200 00
2021	17151830 0	2421472 0	123839470 .6	13099924 80	321131752 7	123993456 .4	179193308 00	232399041 0	63050200 00
2022	17291900 0	2421472 0	124339470 .6	13104050 80	321131752 7	136134036 .4	179193308 00	232399041 0	63050200 00
2023	17291900 0	2421472 0	124339470 .6	13104050 80	321131752 7	136134036 .4	179193308 00	232399041 0	63050200 00
2024	18022080 0	2421472 0	124339470 .6	13314735 80	321131752 7	234134036 .4	179193308 00	232399041 0	63050200 00

Source: Prepared by the researcher using 198 official and institutional sources, including free-zone authorities, government agencies, investment promotion agencies, customs authorities, government reports, and other relevant institutional publications.

Blank cells in the underlying free-zone-area dataset may have two meanings. First, they may indicate that sufficient documentary evidence was unavailable to determine the free-zone area for the corresponding year. Second, for Cambodia in 2000 and 2001, the underlying documentary evidence indicates that no free-zone area existed; these observations were recorded as zero in the original area dataset but were subsequently treated as blank in the logarithmic series because the natural logarithm of zero is undefined. Therefore, blank cells should not be interpreted as indicating the absence of free zones. A value of zero in the original dataset was reported only when the available sources indicated that no free-zone area existed during the corresponding year.

Table 2. Hausman Specification Tests for PMG Estimator Selection

comparison	Chi-square	df	P-value	Decision
PMG vs MG	10.8701	4	0.0281	Reject H_0
PMG vs DFE	2.0402	4	0.7284	DO not reject H_0

The Hausman specification tests assess the appropriateness of the alternative estimators. The statistically significant PMG–MG test ($p = 0.0281$) rejects the null hypothesis of no systematic difference between the two estimators, indicating that the assumption of homogeneous long-run

coefficients imposed by the PMG estimator is not fully supported relative to the unrestricted MG estimator. In contrast, the PMG–DFE comparison is statistically insignificant ($p = 0.7284$), indicating no statistically significant difference between the two estimators.

Given these results, the PMG estimator is retained as the main specification because the study is primarily concerned with estimating a common long-run association while allowing short-run dynamics and adjustment coefficients to vary across countries. However, the rejection of PMG in favor of MG is explicitly acknowledged as a limitation of the homogeneous long-run specification. To assess the sensitivity of the findings to alternative assumptions about long-run homogeneity, the corresponding MG and DFE estimates are also reported in Table 6. These alternative estimates provide a basis for assessing the sensitivity of the estimated long-run relationships to the choice of estimator, rather than treating the PMG specification as uniquely supported by the Hausman test.

FINDINGS AND DISCUSSION

Table 3. Results of Unit Root Test (Im, Pesaran, and Shin)

Variables	Level (I0)	First Difference (I1)	Integration Degree
	Intercept	Intercept	
LNNFDIS	-2.04614 (0.0204)		I(0)
LNfZ	-1.96329 (0.0248)		I(0)
LNGGFC	2.64538 -(0.0041)		I(0)
LNLFP	-0.12910 (0.4486)	7.87160 -(0.0000)	I(1)
LNURB	0.84372 (0.8006)	-13.6779 (0.0000)	I(1)

Table 3, the unit root test for model variables in the study sample countries, shows that the variables used in the study are divided into two types in terms of the degree of stationarity. It indicates that some variables, such as the logarithm of foreign direct investment stock (LNNFDIS) and the logarithm of free zones (LNfZ), are stationary at level I(0) when there is a constant or a constant and a trend, indicating the absence of a unit root problem at a significance level of (5%). (LNGGFC), on the other hand, is stationary at level I(0) when there is a constant and stationary after the first difference I(1) when there is a constant and a trend. As for the variables (LNLFP) and (LNURB), it is shown that they are stationary after the first difference I(1); that is, they contain a unit root at the level but become stationary after the first difference, according to P-values that were greater than (0.05) at the level and less than (0.05) after the first difference when there is a constant or a constant and a trend.

Table 4. Fisher Combined Johansen Cointegration Test

Johansen Fisher Panel Cointegration test
Series: LNNFDIS LNfZ LNGGFC LNLFP LNURB
Sample: 2000-2024
Included observations: 225

Trend assumption: Case 3 (Johansen- Hendry- Juselius): Cointegrating relationship includes a constant. Short-run dynamics include a constant				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace and Maximum Eigenvalue				
Hypothesize No. of CE (s)	Fisher Stat (from trace test)	prob	Fisher Stat (from max -eigen test)	prob
None	305.4	0.0000	205.6	0.0000
At most 1	145.4	0.0000	81.89	0.0000
At most 2	79.64	0.0000	45.25	0.0004
At most 3	52.15	0.0000	37.37	0.0047
At most 4	47.75	0.0002	47.75	0.0002
Probabilities are computed using the asymptotic chi-square distribution				

Table 4 presents the results of the cointegration test using the Johansen-Fisher panel cointegration method. Based on the Trace Test and the Max-Eigen test for both methods, the significance level was below 5% (0.05) for all hypotheses. Thus, we reject the null hypothesis, which states that there is no cointegration, and accept the alternative hypothesis, which confirms the existence of a strong cointegration relationship between the variables. This means that the variables move together in the same direction in the long run.

Table 5. (PMG/ARDL)

Dependent Variable :D (LNNFDIS)				
Method: ARDL				
Sample: 2003 2024				
Included observations: 209				
Number of cross- sections: 9				
Max. dependent lags: 1(fixed)				
Fixed -lag linear regressors: LNFZ LNGGFC LNLFP LNURB				
Deterministic: Unrestricted constant and no trend (case3)				
Selected model: PMG(1,1,1,1,1)				
Variable	Coefficient	Std. Error	t-Statistic	Prob
Long Run				
LNFZ	0.056116	0.015889	3.531838	0.0005
LNGGFC	0.411437	0.164946	2.494374	0.0134
LNLFP	2.619742	0.529387	4.948633	0.0000
LNURB	0.636087	0.213564	2.978434	0.0032
Short Run				

COINTEQ	-0.357446	0.108371	-3.298351	0.0011
LNfZ) D(	0.007129	0.067389	0.105794	0.9159
D(LNGGFC)	0.319216	0.130793	2.440622	0.0155
LNLFp) D(	-1.301583	1.010652	-1.287865	0.1993
LNURB) D(	2.323041	8.291657	0.280166	0.7796
C	-6.060701	1.875573	-3.231386	0.0014
Log-Likelihood: 225.6637				

Table 5 shows that the long-run variables, namely the logarithm of free zones (LNfZ), the logarithm of government spending (LNGGFC), the logarithm of labor force participation (LNLFp), and the logarithm of urbanization (LNURB), are statistically significant at the 5% level, as their p-values are below 0.05. All four variables have positive long-run coefficients, indicating positive long-run associations with FDI stock.

The coefficient on LNfZ is 0.056116 and is statistically significant at the 5% level ($p = 0.0005$), indicating a positive long-run association between free-zone area and FDI stock. The coefficient on government spending (LNGGFC) is 0.411437 and is statistically significant ($p = 0.0134$), indicating a positive long-run association between government spending and FDI stock. The labor force participation variable (LNLFp) has the highest coefficient, at 2.619742, and is statistically significant ($p = 0.0000$). This indicates a positive long-run association between labor force participation and FDI stock in the estimated model. The urbanization variable (LNURB) has a coefficient of 0.636087 and is statistically significant ($p = 0.0032$), indicating a positive long-run association between urbanization and FDI stock.

Regarding the short-run results, the error-correction coefficient (COINTEQ) is -0.357446 and is statistically significant at the 1% level ($p = 0.0011$). The negative, statistically significant coefficient supports the existence of a long-run equilibrium relationship among the variables. The coefficient indicates that approximately 35.7% of the deviation from the long-run equilibrium is corrected within one period.

The coefficient on the change in free-zone area, D(LNfZ), is 0.007129, positive but not statistically significant ($p = 0.9159$). This indicates that short-run changes in free-zone area are not significantly associated with FDI stock in the estimated model. The difference between the short-run and long-run results suggests that the association between free-zone development and FDI stock may become more evident over a longer adjustment period.

The coefficient on the change in government spending, D(LNGGFC), is 0.319216 and is statistically significant at the 5% level ($p = 0.0155$). This indicates a positive and statistically significant short-run association between changes in government spending and the FDI stock.

The estimated coefficient on the change in labor force participation, D(LNLFp), is -1.301583, negative but not statistically significant ($p = 0.1993$). This indicates that short-run changes in labor force participation are not statistically significantly associated with FDI stock in the estimated model. In contrast, the positive and statistically significant long-run coefficient indicates that the association between labor force participation and FDI stock is more evident over the longer adjustment period.

The coefficient on the change in urbanization, D(LNURB), is 2.323041, positive but not statistically significant ($p = 0.7796$). This indicates that short-run changes in urbanization are not

statistically significantly associated with FDI stock, whereas urbanization exhibits a positive and statistically significant association with FDI stock in the long run.

The constant term is -6.060701 and is statistically significant ($p = 0.0014$). However, the constant term is not taken as direct evidence of specific omitted factors affecting FDI; rather, it represents the model's estimated intercept.

Table 6. Comparison of Long-Run Coefficients across PMG, MG and DFE Estimators

Variable	PMG	MG	DFE
LNfz	0.056116	0.105390	0.028977
LNGGFC	0.411437	0.713135	0.482050
LNLFp	2.619742	0.310151	0.884543
LNURB	0.636087	8.923344	0.926374

Note: PMG = Pooled Mean Group; MG = Mean Group; DFE = Dynamic Fixed Effects. The PMG Hausman specification test yields a p-value of 0.0281 for the PMG–MG comparison and 0.7284 for the PMG–DFE comparison.

To assess the sensitivity of the PMG specification to alternative estimators, the long-run coefficients from the PMG estimator are compared with those from the Mean Group (MG) and Dynamic Fixed Effects (DFE) estimators. The PMG Hausman specification test indicates a statistically significant difference between the PMG and MG estimators ($p = 0.0281$), suggesting that the assumption of homogeneous long-run coefficients underlying the PMG estimator is not fully supported relative to the unrestricted MG estimator. In contrast, the comparison between PMG and DFE yields a p-value of 0.7284, indicating no statistically significant difference between the two estimators. The MG and DFE estimates are therefore reported as alternative specifications to assess the sensitivity of the estimated long-run relationships to the choice of estimator.

CONCLUSIONS

This study examined the long-run and short-run associations between free zones and foreign direct investment in nine developing countries using the Panel ARDL framework. The study period spans 2000–2024, but the effective econometric estimation period is 2003–2024 due to the model's lag structure. The empirical findings indicate a positive and statistically significant long-run association between cumulative free-zone area and FDI stock, whereas the short-run association is not statistically significant. These findings suggest that the relationship between free-zone development and FDI stock becomes more evident over a longer adjustment period. The study also shows that government spending, labor force participation, and urbanization are positively and statistically significantly associated with FDI stock in the long run. In the short run, only changes in government spending exhibit a statistically significant positive association with FDI stock. These findings indicate that the relationship between FDI and free-zone development may depend on broader macroeconomic and structural conditions rather than on free-zone expansion alone.

The findings also suggest that the development of free zones should be considered within the broader investment environment. Infrastructure, public services, labor availability, urban development, and other complementary economic conditions may influence the extent to which free-zone development is associated with FDI accumulation. Therefore, free-zone development can be examined as part of a wider policy framework for trade facilitation, investment promotion, and economic development. From a theoretical perspective, the study contributes to the free-zone and

FDI literature by linking the physical development of free zones, measured by cumulative area, to the dynamic process of FDI accumulation. The findings provide evidence of a positive long-run association while showing that this relationship is not statistically significant in the short run. This distinction contributes to the literature by considering both the scale of free-zone development and the time dimension of its relationship with FDI. Overall, the findings indicate that the development of free zones is positively associated with FDI stock over the long run within the countries and period examined. However, given the observational nature of the data and the mixed evidence from the estimator specification tests, the results should be interpreted as empirical associations rather than definitive causal effects.

LIMITATION & FURTHER RESEARCH

This study has several limitations that should be considered when interpreting the findings. First, the sample is limited to nine developing countries due to data availability and comparability, which restricts the generalizability of the results to other developing or developed economies. Second, cross-country differences in the definition, designation, development, and operation of free zones may affect the comparability of the free-zone-area data. In particular, the cumulative area indicator is based on documented area information and does not necessarily reflect the actual operational capacity or utilization of each zone.

Third, the construction of the free-zone-area indicator depends on the availability and consistency of historical data from official and institutional sources. Differences in reporting practices across countries may therefore introduce comparability issues. Fourth, the PMG approach assumes that the long-run coefficients are homogeneous across countries in the panel, even though countries may differ in their institutional environments and in how free zones operate. Fifth, the relatively short country-level time series and the presence of common regional or global shocks may affect the estimated relationships. Finally, the observational nature of the data means that reverse causality between FDI and free-zone development cannot be completely ruled out.

An additional limitation concerns how zero values in the free-zone-area data are handled. In Cambodia, the underlying data indicate that no free-zone area existed in 2000 and 2001. Because the natural logarithm of zero is undefined, these observations were recorded as zero in the original area dataset but treated as missing in the logarithmic series used for the analysis. In addition, although the underlying dataset covers 2000–2024, the effective estimation sample covers 2003–2024 due to the lag structure of the Panel ARDL model. This difference between the overall data period and the estimation period should be considered when interpreting the empirical results.

Future research could address these limitations by expanding the sample, developing more standardized measures that distinguish designated from operational free zones, incorporating institutional and governance indicators, and using alternative econometric approaches that allow for greater cross-country heterogeneity and potential endogeneity. Future studies could also examine whether the relationship varies across sectors, free zone types, and countries with different institutional and economic characteristics.

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