



Public Education Spending and Primary-Level Exclusion in ASEAN: Policy Insights from a Two-Way Fixed Effects Panel Analysis

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Abstract

This study examines the relationship between public education spending intensity and primary-level educational exclusion across ASEAN member states. Using an unbalanced country-year panel drawn from the World Development Indicators (2000–2024), we estimate a two-way fixed effects model to analyze whether lagged government education expenditure (% of GDP) is associated with reductions in children out of school, primary (% of primary school age), while controlling for system-capacity factors and macroeconomic conditions. Results from the baseline model (N = 150 observations) indicate that lagged spending shows a negative but statistically non-significant association with out-of-school rates ($\beta = -0.340$, $p > 0.10$). In contrast, a restricted sensitivity model incorporating capacity indicators reveals that the proportion of trained teachers is strongly and negatively associated with exclusion ($\beta = -1.0468$, $p < 0.001$). Descriptive analysis confirms substantial and persistent cross-country heterogeneity, with mean out-of-school rates ranging from 0.28% (Singapore) to 12.38% (Lao PDR). The findings suggest that aggregate spending intensity alone is an imprecise predictor of short-run changes in primary-level exclusion within the ASEAN context. Instead, instructional capacity—proxied by teacher training—emerges as a more consistently relevant correlate. The study underscores the importance of moving beyond top-line expenditure ratios toward context-sensitive strategies that strengthen resource-to-service translation, prioritize teacher capacity, and address the pronounced heterogeneity in educational access across ASEAN systems.

Keywords: *ASEAN; education spending; out-of-school children; teacher training; panel data; fixed effects; educational exclusion*

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1. Introduction

The provision of universal and inclusive primary education remains a cornerstone of sustainable development and a fundamental objective for nations worldwide. As a primary indicator of educational system performance and equity, the rate of children out of school reflects the effectiveness of policies aimed at ensuring access, retention, and completion. In the dynamic and diverse region of Southeast Asia, the Association of Southeast Asian Nations (ASEAN) presents a critical context for examining the drivers of educational exclusion. Member states exhibit wide disparities in economic development, governance capacity, demographic pressures, and historical educational attainment, leading to significant variation in the prevalence of primary-level out-of-school children.

Public education expenditure is a primary policy lever governments employ to address barriers to schooling. Conventional wisdom and substantial literature posit a positive relationship between increased financial investment in education and improved access outcomes. However, the translation of aggregate spending into tangible reductions in exclusion is not automatic. The efficacy of education spending is moderated by a complex array of factors, including the quality of governance, the efficiency of resource allocation, the capacity of the teaching force, and underlying socio-economic conditions. In regions marked by heterogeneity, such as ASEAN, understanding which factors condition the relationship between spending and inclusion is essential for effective policymaking.

Existing empirical evidence offers mixed conclusions. While some cross-national studies affirm the positive role of public spending on enrollment, others highlight the diminishing returns or the critical mediating roles of institutional quality, targeted interventions, and system-specific capacities. Much of this literature relies on cross-sectional analyses or pooled models that may obscure important, persistent differences between countries. For a region like ASEAN, where unobserved historical, cultural, and institutional factors vary significantly, methodologies that account for this inherent heterogeneity are necessary to derive unbiased and actionable insights.

This study investigates the relationship between public education spending intensity and primary-level educational exclusion across ASEAN countries. Employing a longitudinal panel research design, it utilizes a two-way fixed effects model to analyze unbalanced country-year data drawn from the World Development Indicators (WDI). The analysis controls for key system-capacity factors, including pupil-teacher ratios and teacher training, as well as macroeconomic conditions, to isolate the association between resource allocation and out-of-school prevalence while accounting for time-invariant country characteristics and common temporal shocks.

By adopting this approach, the study aims to contribute to the literature on educational finance and policy in three key ways. First, it provides a region-specific, longitudinal analysis of the spending-exclusion nexus within the under-studied yet strategically important ASEAN context. Second, it assesses the relative importance of structural capacity indicators alongside fiscal effort. Third, it demonstrates the methodological necessity of controlling for unobserved country-level heterogeneity when evaluating the impact of public expenditure on educational outcomes. The findings seek to inform educational leadership and management by clarifying the conditions under which financial investments are most likely to translate into measurable gains in school inclusion.

1.1 Objectives of the Study

This study seeks to investigate the relationship between public education spending and primary-level educational exclusion across ASEAN member states. Its primary aim is to determine whether variations in government expenditure on education, measured as a share of GDP, are associated with changes in the rate of children out of school, while accounting for the significant and persistent differences between countries. To achieve this, the analysis employs a longitudinal panel data framework, focusing specifically on how this relationship is mediated by critical education-system capacity indicators, such as pupil-teacher ratios and the proportion of trained teachers. Furthermore, the study examines the influence of broader macroeconomic conditions, proxied by GDP per capita, on patterns of exclusion.

In addition to these core inquiries, the research quantifies the extent of cross-country heterogeneity in out-of-school rates to isolate the unique, time-invariant factors affecting each nation. Robustness and sensitivity analyses are integral to the methodology, designed to test the stability of the findings under different model specifications and data availability scenarios. Ultimately, by clarifying the conditions under which financial investment translates into improved access, the study intends to generate evidence-based implications for educational leadership, management, and policymaking within the ASEAN region, focusing on strategies for enhancing resource allocation and strengthening systemic capacity.

2. Review of Literature

2.1 Spending Intensity and Exclusion

Higher public education expenditure, particularly in low- and middle-income countries (LMICs) and sub-Saharan Africa, is generally associated with improved educational outcomes such as increased enrollment and reduced gender inequality in education, which indirectly suggests lower out-of-school rates at the primary level (Mbodji, 2024; Mbodji, 2023; Zhou, 2025). Studies in sub-Saharan Africa show that public spending positively affects primary and secondary education enrollment, although the impact varies by education level and is influenced by factors like gender inequality and institutional capacity (Mbodji, 2024; Mbodji, 2023; Farayibi & Folarin, 2021). In contexts like the Philippines, digital transformation in higher education is widespread, yet its framing often prioritizes continuity over strategic, equitable investment, suggesting that without intentional targeting, increased spending may not automatically address exclusion (Atento, 2025a). In Nigeria, public spending combined with socio-economic factors such as unemployment and insecurity influences out-of-school rates, indicating that expenditure alone may not suffice without addressing local conditions (Nwoke, Oyiga, & Cochrane, 2024; Lumi, Faruk, Jummare, & Ahmed, 2025). Evidence from Indonesia highlights that while education expenditure improves graduation rates, it does not directly increase school participation, suggesting that spending must be complemented by other supportive policies (Suharto, Hasanuddin, Jiuhardi, & Lestari, 2025). Investments in school infrastructure and teacher quality also play a critical role in enhancing enrollment and reducing exclusion in LMICs (Zhou, 2025; Lumi et al., 2025). Overall, higher public education expenditure tends

to associate with lower primary out-of-school rates, but its effectiveness depends on equitable allocation, socio-economic context, and complementary interventions (Nwoke et al., 2024; Mbodji, 2024; Mbodji, 2023; Zhou, 2025).

2.2 Allocation and Targeting Quality

Targeted spending approaches such as equity-based funding, conditional cash transfers, school feeding, and transport subsidies tend to reduce primary out-of-school rates more reliably than simply increasing aggregate education spending. Evidence from Nigeria highlights the importance of context-specific, household-level interventions that address socio-economic barriers and insecurity, suggesting that targeted policies are more effective in improving access to education (Nwoke et al., 2024). This aligns with research in the Philippines and ASEAN region, which finds that macro-level economic strength does not automatically translate into equitable human development outcomes; instead, targeted, inclusive policies that address specific family and community needs—such as childcare support and nutrition-sensitive programs—are essential for converting resources into tangible gains (Quinto & Atento, 2025). Research from the U.S. shows that targeted funding to low-resource, high-poverty districts yields larger achievement gains and can reduce inequality, especially when funds support teacher salaries and counselors (Rauscher, Mellon, Loeb, & Abott, 2025). Furthermore, understanding local community values and drivers, as seen in studies of educational ecosystems, is crucial for designing effective, targeted interventions that resonate with beneficiaries (Atento & Espelita, 2025). Experimental evidence from Uganda indicates that incentives tied to student performance can reduce dropout rates, particularly when combined with resources like textbooks (Gilligan, Karachiwalla, Kasirye, Lucas, & Neal, 2022). Broader studies in Africa emphasize that increased government spending improves enrollment and completion rates, but innovative, targeted approaches are necessary to address regional inequalities and specific barriers to education (Mwambi et al., 2025). Systemic barriers such as digital access and cost also underscore that even well-intentioned spending on technology must be carefully targeted to avoid exacerbating equity gaps (Rao, Tian, & Atento, 2025). Overall, targeted spending mechanisms appear more effective at reducing primary out-of-school rates than undirected increases in aggregate spending, especially when they address local socio-economic and infrastructural challenges (Nwoke et al., 2024; Gilligan et al., 2022; Rauscher et al., 2025; Mwambi et al., 2025). Although focused on higher education rather than primary schooling, evidence from Region IV-A indicates that enrollment-related communication is mediated by trust, relevance, and digital engagement, suggesting that access interventions may require locally resonant outreach rather than generic information campaigns (Espelita, Atento, & Atento, 2026).

2.3 Teacher Capacity Mechanism

Teacher quality and capacity, including the proportion of trained teachers and their instructional competence, are generally associated with improved educational outcomes, but direct evidence linking these factors to lower primary out-of-school rates is limited. Research from Tanzania shows that rapid enrollment growth led to higher pupil-teacher ratios and reduced observable teacher quality, which negatively affected test scores, especially in urban areas, suggesting that teacher quality impacts learning retention but may not directly reduce out-of-school rates (Valente, 2019). Studies in England find that teacher effects significantly influence pupil progress in reading and mathematics, though no clear evidence links teacher quality to attendance, a proxy for retention (Jerrim et al., 2025). In specialized education sectors like health professions, systemic challenges including faculty burnout and moral distress highlight that teacher capacity is not just about training but also about workload, institutional support, and systemic well-being—factors that indirectly affect educational quality and student persistence (Bermido, Quinto, & Atento, 2025). Positive teacher-student relationships are strongly associated with better student attitudes and prosocial behaviors, which can indirectly support retention and engagement in school (Longobardi, Settanni, Lin, & Fabris, 2020). In the context of integrating new methodologies like e-learning, sustained faculty development is identified as a critical need for effective implementation, suggesting that spending on teacher capacity must be ongoing and pedagogically aligned (Atento, 2025a). While teacher training and qualifications are important for instructional quality, their direct impact on reducing primary out-of-school rates remains less clearly established in the available research (Ndongfack, 2025; Mecherie & Boualli, 2025). Overall, teacher quality contributes to improved retention and learning outcomes, but its direct association with lowering out-of-school rates requires further investigation (Valente, 2019; Jerrim et al., 2025; Longobardi et al., 2020). Adjacent workforce-planning literature similarly frames competency alignment and pipeline modernization as system-level capacity issues, implying that trained-teacher coverage should be interpreted as part of a broader readiness and deployment ecosystem rather than merely as an individual qualification indicator (Atento, Quinto, & Espelita, 2025).

2.4 Staffing density and classroom load

Lower pupil-teacher ratios or reduced class sizes are generally associated with better learning environments, but direct evidence linking them to lower primary out-of-school rates is limited. Studies in Tanzania and Nigeria

show that high pupil–teacher ratios contribute to overcrowded classrooms, teacher burnout, and reduced instructional quality, which can negatively affect student engagement and academic outcomes (Valente, 2019; Opanuga, Okagbue, Oguntunde, Bishop, & Ogundile, 2019). Research from Zambia highlights that overcrowding leads to increased disruptive behavior and less effective classroom management, suggesting that lower ratios could improve persistence by creating more conducive learning conditions (Chungulo, Saishi, Thelma, Phiri, & Kabombo, 2025). However, evidence directly connecting lower pupil–teacher ratios to improved enrollment continuity or reduced out-of-school rates is not clearly established in the available research (Chansa, 2023). While smaller class sizes improve teaching quality and student behavior, their impact on reducing dropout rates or increasing enrollment persistence requires further study (Valente, 2019; Chungulo et al., 2025; Chansa, 2023). Overall, lower pupil–teacher ratios support better classroom dynamics, which may indirectly contribute to improved retention, but conclusive evidence on out-of-school rates is lacking (Valente, 2019; Chungulo et al., 2025).

2.5 Macroeconomic conditions and vulnerability

Macroeconomic improvements such as GDP per capita growth, reduced poverty, and improved household income are generally associated with lower primary out-of-school rates, but the relationship is complex and context-dependent. Studies show that economic insecurity, including food price volatility and poverty, increases the likelihood of school dropout, especially among vulnerable groups, indicating that better economic conditions can reduce dropout rates (Brown, Haer, & Østby, 2023; Ali, Yaseen, Makhdum, Quddoos, & Sardar, 2021). Research in ASEAN economies demonstrates a clear but heterogeneous link between macroeconomic buffers (like foreign reserves and purchasing power) and child welfare outcomes; however, it crucially argues that economic stability alone is insufficient without policies that ensure inclusive growth and protect vulnerable households, a principle directly applicable to educational persistence (Quinto & Atento, 2025). Furthermore, individual awareness of economic concepts like monetary policy is linked to more future-oriented financial behaviors (saving and investing), suggesting that broader economic literacy within a population could influence decisions about investing in education (Espelita et al., 2025). Research from Turkey and Spain suggests that labor market conditions and unemployment rates influence educational decisions and academic performance, with better macroeconomic conditions supporting higher school persistence (Gunes & Marchand, 2020; Guío, Choi, & Escardíbul, 2018; Martín-González, González-Betancor, & Pérez-Esparrells, 2024). However, some evidence from the U.S. indicates that adverse economic conditions can sometimes increase school leaving due to higher opportunity costs or risk aversion, highlighting variation across countries and contexts (Witteveen, 2020). Socioeconomic factors remain critical determinants of dropout, and improvements in household income and employment opportunities are recommended to support enrollment continuity (Ali et al., 2021; Fatima, Suhag, Ali, Shah, & Shanzay, 2024; Moreno, Rincón, Carmona, Támara, & Galindo, 2025). Overall, macroeconomic improvements tend to be linked with lower out-of-school rates after controlling for fixed factors, but effects vary by region, household characteristics, and local economic conditions (Brown et al., 2023; Gunes & Marchand, 2020; Guío et al., 2018).

2.6 Governance and implementation effectiveness

Governance and implementation factors such as decentralization capacity, corruption control, school accountability, and monitoring systems significantly influence whether educational spending effectively reduces primary out-of-school rates. Evidence from Sindh, Pakistan, shows that decentralized governance in public-private partnership schools allows more adaptive leadership and better community engagement, which improves enrollment and retention compared to centralized government schools (Rind, 2024). A conceptual framework on diplomatic credibility argues that effective external outcomes are fundamentally endogenous to domestic governance integrity, implying that the success of any public policy, including education spending, is contingent on the quality of domestic institutions and implementation capacity (Atento, 2025b). In Nigeria, poor government commitment, insecurity, and weak monitoring undermine the impact of public spending on education, suggesting that governance quality is critical for translating resources into improved access (Nwoke et al., 2024; Terlumun & Manasseh, 2025). A cross-country study finds that increases in government revenue lead to higher school attendance, but this effect is strongly mediated by the quality of governance, with better governance amplifying the positive impact of spending on primary education (Hall & O'Hare, 2024). Sub-Saharan African countries with weak monitoring and evaluation systems struggle to reduce out-of-school rates despite free primary education policies, highlighting the need for strong accountability mechanisms (Njeru, 2019). In the education sector, systemic reviews point to the need for leadership that can balance quality assurance, faculty support, and resource constraints, underscoring governance as a mediating function for effective implementation (Bermido, Quinto, & Atento, 2025). Overall, effective governance and implementation capacity are essential moderators that determine whether increased educational spending results in lower primary out-of-school rates (Rind, 2024; Nwoke et al., 2024; Hall & O'Hare, 2024; Njeru, 2019). Related implementation research in hospital accreditation likewise

shows that middle managers may support quality-oriented reforms while still encountering resource and documentation constraints, suggesting that governance effectiveness depends on operational capacity as much as policy intent (Garcia & Atento, 2026).

2.7 Research gaps

The synthesis of existing literature reveals several critical gaps that constrain a comprehensive understanding of how public education spending influences primary out-of-school rates. While the relationships between expenditure, teacher capacity, macroeconomic conditions, and governance are established in varying depths, the following areas require targeted investigation to inform more effective policy:

1. **Context-Specific Pathways from Spending to Inclusion:** While cross-national studies establish general associations, there is a lack of granular, context-specific models that trace the causal pathways through which education budgets are allocated, managed, and ultimately affect household decisions to keep children in school within specific local settings (e.g., rural vs. urban, conflict-affected areas). Research is needed that moves beyond correlation to map the implementation chain within specific governance and socio-economic contexts.
2. **The Governance "Black Box":** Although governance is identified as a critical moderator, few studies deconstruct the specific institutional mechanisms—such as fiduciary controls, community oversight committees, or real-time expenditure tracking—that most effectively translate allocated funds into accessible, quality schooling and reduce leakage or misallocation that directly contributes to student dropout.
3. **Direct Linkages Between Teacher Ecosystem Factors and Out-of-School Rates:** Existing research strongly links teacher quality and classroom conditions to learning outcomes, but empirical evidence directly connecting these factors to the decision to withdraw a child from school remains sparse. Research is needed to examine whether and how improvements in teacher support, reduced burnout, and better classroom management directly influence parental and student perceptions of school value enough to sustain enrollment.
4. **Interplay of Targeted Spending and Community-Level Social Capital:** The literature advocates for targeted interventions but often overlooks how the effectiveness of such spending (e.g., on conditional cash transfers, school feeding) is amplified or diminished by pre-existing community social capital, informal safety nets, and local trust in institutions. Understanding this interaction is key to designing programs that do not fail due to contextual social fragility.
5. **Macroeconomic Policy Channels to Educational Persistence:** While macroeconomic stability is linked to lower dropout rates, research gaps exist in identifying the most effective policy channels for insulating education from economic shocks. Comparative studies are needed on the protective efficacy of different social protection schemes (e.g., unemployment benefits, child allowances) versus direct educational subsidies in sustaining enrollment during periods of volatility.
6. **Methodological Gaps in Disentangling Effects:** A predominant reliance on cross-sectional data and correlational analysis limits causal inference. There is a significant gap in longitudinal, mixed-methods, and quasi-experimental studies that can better isolate the effect of specific spending components (e.g., infrastructure vs. teacher salaries) on out-of-school rates while controlling for concurrent socio-political changes. Comparable ASEAN WDI-based panel work on formal business entry has similarly shown that longitudinal country-year designs can reveal structural heterogeneity that pooled regional summaries obscure, supporting the present study's use of panel specifications to avoid treating ASEAN as a single homogeneous policy space (Atento, 2026).
7. **Gaps in Specific Regional and Disciplinary Knowledge:** As evidenced by the integrated Philippine studies, there is an opportunity to deepen research in ASEAN and other middle-income contexts where macroeconomic growth, digital transformation, and governance reforms are ongoing. Furthermore, integrating insights from behavioral economics, political science, and implementation science into educational expenditure research remains underexplored.

Addressing these gaps requires interdisciplinary research designs that combine quantitative analysis of spending and outcomes with qualitative inquiry into implementation processes and household decision-making. Filling these knowledge voids is essential for moving from general associations toward a refined, actionable theory of change for using public investment to ensure inclusive and continuous primary education.

3. Methodology

3.1 Research design

The study employed a quantitative, longitudinal panel research design using an unbalanced country–year dataset. The design examined the association between public education resource allocation and educational exclusion outcomes across ASEAN economies over time. A panel approach was selected to account for both cross-country differences and within-country changes across years, enabling a stronger governance- and management-oriented interpretation than cross-sectional comparisons.

3.2 Data Source

All variables were obtained from the World Bank’s World Development Indicators (WDI) database and consolidated into a country–year panel file for analysis. WDI was selected due to its standardized definitions, cross-country comparability, and routine use in education policy and system-level analytics.

3.3 Study Scope and Unit of Analysis

The unit of analysis was the country-year. The intended scope covered ASEAN economies over the period 2000–2024 (or the maximum available overlap for each indicator within this range). The dataset is unbalanced, as not all countries report complete series for all years. Non-ASEAN reporting economies (e.g., Hong Kong SAR, Macao SAR) and “China variants” may exist in WDI exports; however, the primary analysis is anchored on ASEAN membership, and any non-ASEAN economies—if retained—are treated strictly as descriptive comparators rather than as part of the ASEAN panel.

3.4 Variables and Measurement

Dependent Variable

Educational exclusion (primary level) was operationalized using the indicator:

Children out of school (% of primary school age)

WDI Code: SE.PRM.UNER.ZS

Measurement: percentage of children of official primary school age who are not enrolled in primary or secondary school.

Interpretation: higher values indicate greater exclusion and weaker access/retention performance at the primary stage.

Main Independent Variable

Public education spending intensity was measured using:

Government expenditure on education, total (% of GDP)

WDI Code: SE.XPD.TOTL.GD.ZS

Interpretation: greater spending intensity is expected to be associated with lower out-of-school prevalence, subject to governance effectiveness and allocation efficiency.

Control Variables

To reduce omitted variable bias and reflect management-relevant capacity conditions, the following controls were included where available:

Pupil–teacher ratio, primary

WDI Code: SE.PRM.ENRL.TC.ZS

Interpretation: higher ratios indicate higher classroom load and potentially weaker instructional capacity.

Trained teachers in primary education (% of total primary teachers)

WDI Code: SE.PRM.TCAQ.ZS

Interpretation: higher values indicate stronger teacher qualification capacity.

GDP per capita (current US\$)

WDI Code: NY.GDP.PCAP.CD

Interpretation: macroeconomic capacity control, reflecting fiscal space and baseline development level that can influence schooling access.

Measurement Interpretation for Leadership and Management. Consistent with an educational leadership and management lens, the dependent measure represents a system-level inclusion outcome, while spending and capacity indicators represent policy and managerial levers (resource intensity, staffing adequacy, and teacher qualification). All indicators are interpreted as system metrics suitable for cross-national benchmarking and longitudinal tracking, rather than as individual-level measures.

3.5 Data Preparation and Management

The WDI indicators were extracted and consolidated into a country–year analytic dataset suitable for panel estimation. The initial export format (years as separate columns per indicator) was restructured into a long format in which each observation corresponds to a unique country–year. Indicators were then merged using standardized country identifiers and calendar year. After merging, the dataset was screened for structural inconsistencies (e.g., duplicate country entries, inconsistent country codes, and non-numeric artifacts), and variable types were standardized to ensure that all measures were treated as continuous metrics in the final model.

Because WDI education indicators may have discontinuities across years, the dataset was examined for series gaps and anomalous values that could reflect reporting interruptions rather than substantive shifts. Data cleaning focused on (a) verifying that values were within plausible ranges for percentage-based indicators, (b) identifying extreme outliers for manual verification against adjacent-year patterns, and (c) ensuring that the merged dataset preserved the correct alignment of predictors and outcomes by year.

For modeling, the analytic file was prepared to support the lag structure specified in the inferential model. Lagged versions of the relevant predictors were generated where required (e.g., $t-1$), ensuring that predictor values precede the outcome year and allowing the model to reflect the expected delay between resource inputs and education access outcomes. The final regression dataset was constructed using observations with non-missing values on the dependent variable and the covariates included in the final specification, consistent with complete-case estimation for the specified model.

3.6 Statistical Treatment and Model Specification

Descriptive Analysis

Descriptive statistics were computed to summarize the distribution of the study variables across countries and years. Measures of central tendency and variability were generated for the dependent variable and all explanatory variables included in the regression specification. Country profiles and time patterns were reviewed to contextualize observed levels and fluctuations in out-of-school prevalence and to support policy-relevant interpretation. Where applicable, descriptive summaries were used to identify periods of notable change that may correspond to regional disruptions or systemic reforms, while maintaining the study’s focus on system-level indicators.

Panel Regression Analysis

The primary inferential approach employed panel regression with fixed effects, structured to account for both cross-country heterogeneity and time-specific shocks. Country fixed effects were used to absorb time-invariant national characteristics, while year fixed effects were used to control for common temporal influences affecting multiple countries in the same period. Predictors were specified with the lag structure described in the data preparation subsection, consistent with the expectation that resource allocation and system capacity indicators affect education access outcomes with delay. The model specification is presented in the equation provided in this section, with terms defined accordingly.

Robust standard errors were used to mitigate heteroskedasticity concerns. Where supported by the statistical software, standard errors were clustered at the country level to address within-country correlation across years. Statistical significance was evaluated using conventional thresholds, while substantive interpretation emphasized effect direction and practical policy meaning rather than sole reliance on p-values.

A representative specification is:

$$\text{OOS}_{i,t} = \beta_1 \text{Spend}_{i,t-1} + \beta_2 \text{PTR}_{i,t-1} + \beta_3 \text{Train}_{i,t-1} + \beta_4 \text{GDPpc}_{i,t-1} + \mu_i + \lambda_t + \varepsilon_{i,t}$$

Where:

- $\text{OOS}_{i,t}$ = children out of school, primary (%) in country i year t
- $\text{Spend}_{i,t-1}$ = education expenditure (% of GDP), lagged one year
- $\text{PTR}_{i,t-1}$ = pupil–teacher ratio, primary (lagged)
- $\text{Train}_{i,t-1}$ = trained teachers in primary education (%) (lagged)
- $\text{GDPpc}_{i,t-1}$ = GDP per capita (lagged)
- μ_i = country fixed effect; λ_t = year fixed effect; $\varepsilon_{i,t}$ = error term

Robustness and Sensitivity Analyses

To assess the stability of results, the model was re-estimated under alternative specifications. These checks included (a) estimating models with and without the full set of controls to examine coefficient stability for the primary spending predictor, (b) comparing estimates under alternative lag assumptions where data availability permitted (e.g., $t - 1$ versus $t - 2$), and (c) conducting subset-based sensitivity checks by re-running the model on a higher-coverage subset of countries to confirm that conclusions were not driven by sparse series.

3.7 Ethical Considerations

The study used secondary, aggregated macro-level data that do not contain personal identifiers. As such, it posed minimal ethical risk and did not involve human subjects. Data use complied with the access and attribution norms of public international statistical repositories.

3.8 Methodological Limitations

The study is subject to limitations inherent in cross-national indicator research: (a) missing data that may reflect reporting capacity rather than true absence of outcomes; (b) potential measurement differences across national statistical systems despite harmonization; and (c) the associational nature of panel estimates, which support policy-relevant inference but do not guarantee strict causality. These limitations were addressed through fixed effects, lagged predictors, and sensitivity analyses.

4. Results and Discussion

4.1 Panel Regression Analysis

4.1.1 Main TWFE results (baseline model)

A two-way fixed effects (TWFE) panel regression model was estimated to examine whether public education spending intensity is associated with primary-level educational exclusion across ASEAN countries over time. The dependent variable was children out of school, primary (% of primary school age), and the key predictors were specified in lagged form ($t-1$). Country fixed effects were included to absorb time-invariant national differences, while year fixed effects were included to control for common temporal shocks and region-wide trends. The final analytic sample comprised 150 country-year observations, representing 10 ASEAN countries across 24 years.

Results indicate that government education expenditure (% of GDP), lagged one year, exhibited a negative association with the out-of-school rate ($\beta = -0.340$), implying that a one-percentage-point increase in spending intensity is associated with an approximate 0.34 percentage-point reduction in the share of primary-age children who are out of school, holding constant country and year effects. However, this coefficient was not statistically significant under either clustered standard errors ($p = 0.464$) or heteroskedasticity-robust HC1 standard errors ($p = 0.223$), suggesting that the observed negative relationship is not sufficiently precise to support a firm statistical conclusion within the present sample and specification.

For the macroeconomic control, GDP per capita (in thousands of US dollars), lagged one year, the estimated coefficient was positive ($\beta = 0.114$). This implies that, within countries over time and net of year effects, higher GDP per capita is associated with a small increase in the out-of-school rate. The estimate was not statistically significant using clustered standard errors ($p = 0.367$), while it reached marginal significance under HC1 robust standard errors ($p = 0.082$). Given the small number of country clusters in the dataset, clustered standard errors are expected to be conservative; therefore, the income-related estimate is interpreted as suggestive rather than conclusive. Overall, the baseline TWFE model does not provide strong statistical evidence that one-year lagged changes in spending intensity, as measured, translate into measurable reductions in primary-level exclusion across ASEAN over the observed period, although the direction of the spending coefficient remains consistent with the expected policy logic. The cross-country time-paths that motivate the subsequent descriptive clustering are presented in Figure 1 under Section 4.3.

4.1.2 Sensitivity check with system-capacity controls (restricted sample)

As a robustness check, the TWFE model was re-estimated by adding lagged education-system capacity indicators—pupil–teacher ratio (primary) and trained teachers in primary education (%). Due to uneven WDI coverage for these indicators, the usable panel reduced to 65 country–year observations across eight ASEAN countries (2001–2019). In this restricted specification, trained teachers exhibited a statistically significant negative association with the primary out-of-school rate ($\beta = -1.0468$; clustered $p = 0.00014$; HC1 $p < .001$), consistent with the expectation that stronger instructional capacity is linked to lower exclusion.

The pupil–teacher ratio was positive ($\beta = 0.6396$) but did not reach significance under clustered inference ($p = 0.287$), while it reached significance under HC1 ($p = 0.032$), indicating sensitivity to the standard-error estimator in a coverage-limited sample. GDP per capita (US dollars, lagged) was statistically significant under both clustered and HC1 inference ($\beta = 0.000503$; clustered $p = 0.0057$; HC1 $p < .001$). Notably, the education spending coefficient changed sign and became positive ($\beta = 1.8244$; clustered $p < .001$; HC1 $p = 0.005$), suggesting that the expanded-controls results are highly sensitive to sample restriction and indicator availability. Accordingly, this specification is interpreted as a sensitivity check rather than the primary ASEAN-wide estimate, as the inclusion of PTR and trained-teacher variables changes the country–year composition of the panel and may induce composition-driven coefficient shifts.

4.2 Descriptive Results: Children Out of School (Primary, %)

Descriptive patterns for children out of school at primary level (% of primary school age) indicate substantial cross-country variation across ASEAN. Based on mean out-of-school prevalence across available years, the highest averages were observed in Lao PDR (mean = 12.38%) and the Philippines (mean = 11.96%), followed by Cambodia (mean = 7.68%) and Malaysia (mean = 6.99%). Mid-range averages were observed in Timor-Leste (mean = 6.48%) and Myanmar (mean = 5.31%, with the important limitation that the most recent observation for Myanmar is 2010). Lower mean prevalence was observed in Indonesia (mean = 3.07%) and Thailand (mean = 2.53%), while the lowest means were recorded for Brunei Darussalam (mean = 1.37%), Viet Nam (mean = 1.02%), and Singapore (mean = 0.28%). Considering the most recent available observations, recent-year out-of-

school prevalence remains comparatively high in Malaysia (2024: 11.97%), Philippines (2024: 11.64%), and Lao PDR

(2024: 10.34%), while Cambodia (2024: 3.69%) and Timor-Leste (2023: 6.88%) show intermediate levels. Lower recent levels were observed for Indonesia (2024: 1.07%), Viet Nam (2024: 1.73%), Thailand (2024: 0.55%), Brunei Darussalam (2023: 0.58%), and Singapore (2023: 0.21%). Overall, the descriptive results suggest persistent disparities across ASEAN systems, implying that leadership and policy strategies to reduce exclusion may need to be differentiated by national context and baseline conditions.

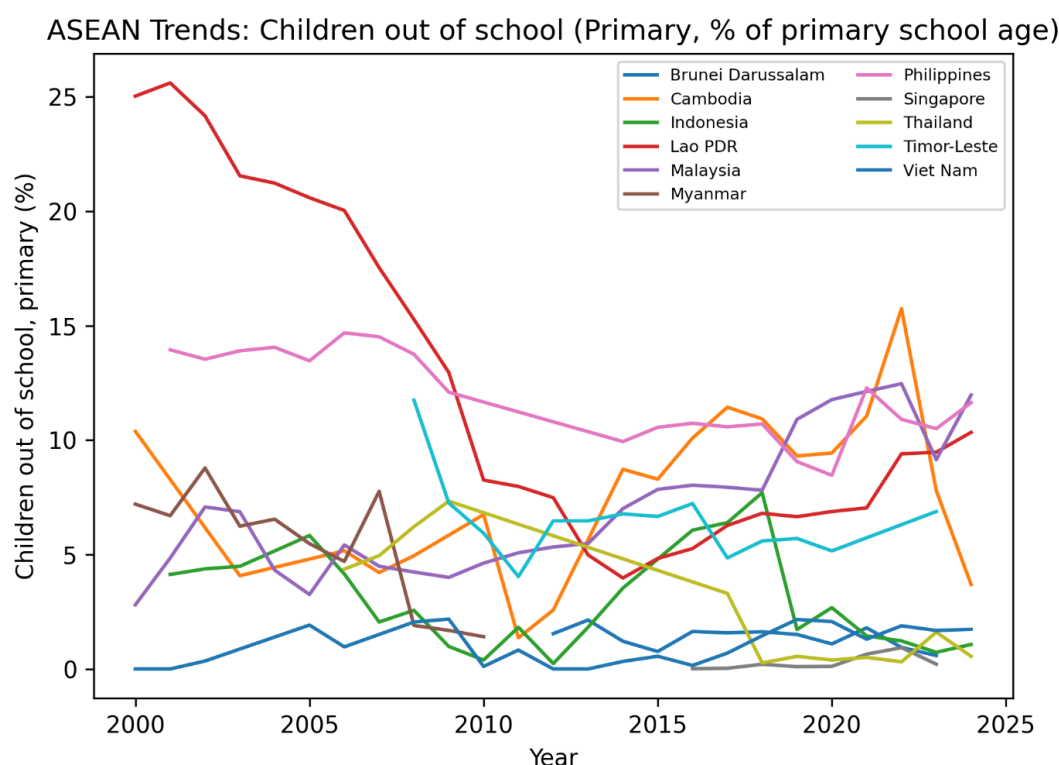


Figure 1 ASEAN Trends: Children out of school (Primary, % of primary school age)

While mean and most recent values provide a clear cross-country snapshot, interpretation should also consider temporal dynamics and data continuity. Several countries show meaningful differences between their long-run averages and their most recent values (e.g., Malaysia's recent rate relative to its mean), which may reflect either real shifts in access/retention conditions or changes in reporting coverage and indicator methodology over time. Moreover, the presence of uneven series recency (e.g., Myanmar's last observation in 2010) highlights the importance of trend-based interpretation and sensitivity checks, particularly when drawing policy or leadership implications from regional comparisons.

4.3 Country Trend Profiles of Primary Out-of-School Rate (Selected ASEAN Cases)

The country trend profiles were examined to contextualize regional heterogeneity in primary-level exclusion. Rather than presenting each country as an isolated case, trajectories were grouped into pattern-based clusters to highlight shared time-path patterns (i.e., persistently higher prevalence, near-floor prevalence, volatility/discontinuities, and series limitations). This clustering is descriptive and is intended to support interpretation of subsequent model-based results. For clarity, the terms “persistently higher” and “near-floor” are used in a comparative descriptive sense (i.e., higher vs. lower observed levels on average within the ASEAN sample over each country's available years), while the other clusters reflect volatility patterns or data-coverage limitations rather than normative judgments about education-system outcomes.

Cluster 1: Persistently higher out-of-school prevalence

Lao PDR

The Lao PDR series shows a pronounced long-run decline in primary-level out-of-school prevalence from the early 2000s to the mid-2010s, followed by a gradual rebound in later years. The out-of-school rate begins at a very high level (above 20% in the early 2000s), declines steadily through the late 2000s, and reaches a low point

around the mid-2010s (approximately 4–5%). From that trough, the trend reverses direction, with a sustained upward movement through the late 2010s and early 2020s, culminating in a recent value slightly above 10% by 2024. This pattern indicates that improvements in primary-level inclusion during the first half of the period were not fully sustained, and that recent years reflect renewed pressure on school participation or changes in measured exclusion.

Philippines

The Philippine trend is characterized by a moderate-to-high out-of-school rate in the early 2000s, a sustained decline through the early-to-mid 2010s, and noticeable volatility in the early 2020s. Values are relatively elevated in the early part of the series (roughly in the 13–15% range), then trend downward across the late 2000s and early 2010s, reaching levels near 10% by around 2014. From the mid-2010s to the late 2010s, the series appears more stable, followed by a marked dip around 2019–2020 and then an abrupt rise around 2021, after which the values settle again in the 10–12% range, ending at approximately 11.6% in 2024. The overall trajectory suggests long-run improvement relative to the early 2000s, but with short-run fluctuations in the most recent period that merit cautious interpretation.

Malaysia

Malaysia's series begins at relatively low-to-moderate levels in the early 2000s, then exhibits a gradual upward trajectory from the late 2000s onward, with a substantial step-up in the late 2010s to early 2020s. After early fluctuations (around the 3–7% range), values stabilize around 4–6% in the late 2000s and early 2010s, then rise steadily through the mid-2010s. The trend shows a notable increase beginning around 2018–2019, with values reaching approximately 11–12% in the early 2020s, followed by a dip and subsequent return to a high recent level near 12% by 2024. This pattern is consistent with a long-run widening of measured primary-level exclusion over time, particularly in the later period, and it aligns with the descriptive finding that Malaysia's most recent value is considerably higher than its long-run mean.

Cluster 2: Lower-prevalence systems

Singapore

Singapore's trend is based on a short series (2016–2023) and therefore should be interpreted as a limited-window profile rather than a long-run trajectory. Values remain very low across the period, with a gradual increase from near-zero levels in 2016–2017 toward approximately 0.2% by 2018, followed by a minor decline and stability around 2019–2020. A noticeable spike is observed in 2021–2022 (approaching around 0.9%), after which the series declines again by 2023 (approximately 0.21%). While the absolute magnitudes remain small compared with other ASEAN systems, the short-term spike highlights that even low-exclusion contexts can experience measurable variation across years, whether due to real shifts in participation or changes in measurement/reporting.

Brunei Darussalam

Brunei Darussalam's series is characterized by consistently low out-of-school prevalence with modest year-to-year variation and a shorter available window relative to other ASEAN countries. Values fluctuate within a narrow band (approximately below 2.2%), including an early peak in the early 2010s, followed by a decline to below 1% around the mid-2010s. From 2016 onward, the series shows relatively stable low levels, with a brief increase around 2021 and a downward movement thereafter, ending near 0.6% by 2023. In substantive terms, Brunei's pattern supports its classification as a low-exclusion system, with variations that remain small in magnitude compared with higher-burden ASEAN cases.

Thailand

Thailand's series (starting mid-2000s) indicates a marked long-run decline from moderate exclusion levels to consistently low out-of-school prevalence in recent years. The rate rises into the late 2000s (peaking above 7%), then trends downward steadily through the early-to-mid 2010s, falling to approximately 3% by around 2017. A sharp reduction is observed around 2018, after which the series remains near the floor (generally below 1%) across 2018–2022. A brief spike is visible around 2023, followed by a return to a lower level by 2024. Overall, Thailand's trajectory is consistent with sustained improvement in primary-level inclusion over time, with recent years reflecting low exclusion and limited volatility.

Viet Nam

Viet Nam's out-of-school trend remains comparatively low throughout the series, but it exhibits intermittent spikes and abrupt drops that distinguish it from a purely flat "low-stable" pattern. The early 2000s begin near zero, followed by a rise and fluctuations in the mid-2000s, reaching values around 2% in the late 2000s. A sharp drop is observed around 2010, followed by short-lived rebounds and near-zero values in the early 2010s. From the mid-2010s onward, the series increases again, peaking around 2019–2020 at just above 2%, before declining and then returning to levels around 1.7–1.9% by 2023–2024. In summary, Viet Nam maintains low absolute exclusion relative to higher-burden ASEAN cases, yet its profile shows episodic shifts that suggest sensitivity to short-run conditions or reporting variation across years.

Cluster 3: High volatility / discontinuities

Cambodia

Cambodia's trend reflects pronounced fluctuations rather than a stable monotonic pattern. The series begins at a relatively high level in 2000 (above 10%), declines sharply in the early 2000s to around 4–5%, and then oscillates through the mid-2000s. A notable discontinuity is observed around 2011, where the rate drops to a low point near 1–2%, followed by a rapid increase through the mid-2010s to double-digit levels. After a period of elevated but variable exclusion in the late 2010s, the series exhibits a sharp spike around 2022 (approaching the mid-teens), followed by a steep decline by 2024 (approximately 3–4%). Overall, Cambodia's profile suggests that primary-level exclusion is sensitive to short-run shifts and/or measurement discontinuities, and the late-period volatility particularly warrants cautious interpretation.

Indonesia

Indonesia's trajectory shows a mix of mid-period improvement, a pronounced mid-2010s increase, and a sharp drop around the late 2010s, followed by relatively low recent values. The series rises modestly in the early 2000s (roughly 4–6%), then declines sharply into the late 2000s and early 2010s to levels near or below 1%. From around 2013 onward, the trend reverses strongly upward, peaking in the mid-to-late 2010s (above 6%, with a high point near 2018). Immediately after this peak, the series drops abruptly around 2019 to below 2%, and remains relatively low and stable thereafter (generally around 1–3%), ending close to 1% by 2024. This pattern indicates substantial structural shifts across the period, with the late-2010s break suggesting either a genuine transition in participation conditions or a discontinuity in reporting/indicator construction.

Cluster 4: Data-limited or truncated series

Timor-Leste

Timor-Leste's trend is based on a later-starting series and should be interpreted within that limited window. The out-of-school rate begins at a relatively high level around 2008 (above 10%), then declines rapidly over the next few years, reaching a low point around 2011 (near 4%). From 2012 onward, the series stabilizes in the mid-range (approximately 6–7%), followed by a noticeable dip around 2017 (near 5%). After 2020, the pattern turns upward again, with a gradual rise through 2023, ending close to 7%. Overall, the trajectory suggests that early progress in reducing primary-level exclusion was followed by a period of stabilization and a mild recent increase, although interpretation should remain cautious due to the shorter series length.

Myanmar

Myanmar's series is truncated and ends in 2010, which substantially limits inference about recent conditions and makes cross-country comparisons with full-period ASEAN series inherently uneven. Within the available timeframe (2000–2010), the out-of-school rate fluctuates at moderate levels in the early 2000s (roughly 6–9%), with a peak around 2002. The series then declines gradually through the mid-2000s, interrupted by a sharp increase around 2007. After 2007, the out-of-school rate drops steeply, reaching values below 2% by 2008–2010. This sharp late-period decline may reflect genuine improvements during that period and/or reporting adjustments; however, because the series does not extend beyond 2010, the trend cannot be linked to later regional developments and must be treated strictly as a historical sub-period profile rather than a current assessment.

Overall, the trend profiles indicate substantial cross-country variation in both baseline levels and temporal stability of primary-level exclusion, with several systems showing sustained improvements, others exhibiting late-period increases, and a subset reflecting volatility or incomplete time coverage.

4.4 Model Diagnostics and Robustness Summary

This section summarizes model fit and the robustness checks conducted for the two-way fixed effects (TWFE) specifications. The baseline TWFE model was estimated on $N = 150$ country–year observations covering 10 ASEAN countries over 24 years, yielding an $R^2 = 0.7089$ and adjusted $R^2 = 0.6228$. Given the relatively small number of country clusters, inference was evaluated using both country-clustered standard errors and heteroskedasticity-robust (HC1) standard errors, recognizing that clustered estimates may be conservative in small-cluster settings. Substantively, the baseline results did not provide strong statistical evidence that lagged education spending intensity is associated with contemporaneous reductions in primary out-of-school prevalence in the full ASEAN panel, although coefficient direction remained consistent with the expected policy logic.

Robustness was further assessed through a sensitivity specification that added lagged education-system capacity indicators (pupil–teacher ratio in primary and trained teachers in primary education). Because these controls have uneven WDI coverage, the expanded model relied on a substantially reduced panel and is interpreted as a sensitivity check rather than the primary ASEAN-wide estimate. In that restricted sample, trained teachers displayed a stable negative association with primary out-of-school prevalence, while the pupil–teacher ratio showed estimator sensitivity (significance under HC1 but not under clustered inference). Importantly, the education spending coefficient changed sign in the expanded specification, indicating that conclusions about spending effects are sensitive to sample restriction and indicator availability. Overall, these diagnostics suggest that ASEAN-wide inference should be anchored on the baseline TWFE specification, while the expanded-controls model is best treated as supportive evidence regarding system-capacity correlates under coverage-limited conditions.

4.5 Discussion of Findings

The present findings provide a nuanced view of education-system “resource intensity” and primary-level exclusion in ASEAN. In the baseline two-way fixed effects model, lagged government education expenditure as a share of GDP exhibited the expected negative direction, indicating that higher spending intensity is associated with lower primary out-of-school prevalence within countries over time. However, the estimate was not statistically precise under either clustered or HC1 inference. This pattern suggests that, in the available ASEAN panel, short-run year-to-year changes in aggregate spending intensity do not reliably translate into measurable reductions in primary-level exclusion once time-invariant national conditions and common year shocks are controlled. Substantively, the sign consistency remains aligned with policy logic, but the baseline evidence does not support a strong claim of immediate or uniform spending effects across heterogeneous systems.

Several plausible interpretations are consistent with this result. First, government education spending as a percent of GDP is an aggregate fiscal intensity measure that may not adequately capture the composition or targeting of spending toward access barriers most relevant to primary-age non-enrolment (e.g., last-mile inclusion, household costs, local school readiness, or community outreach). Two systems may report similar spending intensity while allocating resources differently across levels of education, administrative overhead, or capital projects. Second, the relevant causal pathway may operate through longer implementation horizons than a one-year lag can capture, especially when spending affects exclusion indirectly through teacher deployment, school capacity, or governance reforms. Third, within-country variation in spending intensity may be limited or measured with error, producing attenuation and weak identification after fixed effects absorb persistent cross-country differences.

The restricted-sample sensitivity model adds an important qualification by incorporating system-capacity indicators. In that specification, the share of trained teachers in primary education exhibited a strong negative association with primary out-of-school prevalence, consistent with the interpretation that instructional capacity and teacher preparedness may be more proximal levers for exclusion reduction than aggregate spending intensity alone. In contrast, the pupil–teacher ratio displayed estimator sensitivity, reaching significance under HC1 but not under clustered inference. This divergence is substantively interpretable in two non-exclusive ways: the true relationship may be modest and difficult to estimate in a small coverage-limited sample, and/or the uncertainty estimation may differ under alternative standard-error assumptions given the reduced number of clusters and country-years. Importantly, the spending coefficient changed sign and became positive in the restricted model. This reversal is best read as a warning about sample restriction and indicator availability, rather than as evidence that higher spending increases exclusion. Because the addition of PTR and trained-teacher variables materially

changes country coverage and years included, coefficient shifts can reflect composition effects in the usable panel rather than genuine structural instability in the underlying relationship.

The descriptive results in Sections 4.2 and 4.3 provide context for why uniform effects are difficult to identify. ASEAN systems exhibit pronounced heterogeneity in both baseline prevalence and temporal trajectories of primary out-of-school rates. The cross-country snapshot shows that Lao PDR and the Philippines maintain comparatively high out-of-school prevalence, while Singapore, Brunei Darussalam, Viet Nam, and Thailand remain near the lower bound of the observed range. At the same time, country trend profiles indicate that not all systems follow monotonic improvement paths; some display volatility, discontinuities, or limited series coverage. From an educational leadership and management perspective, this heterogeneity implies that strategies to reduce exclusion must be context-sensitive. Systems facing persistently higher exclusion likely require multi-layered responses that integrate resource mobilization with capacity-building, implementation discipline, and equity-focused governance. Conversely, near-floor systems may focus on sustaining inclusion and preventing relapse during shocks, particularly when short series suggest that apparent increases may reflect measurement, reporting updates, or temporary disruptions.

Taken together, the results support three practical inferences for leadership and pedagogy-oriented policy. First, aggregate spending intensity should not be treated as a stand-alone performance lever; leadership attention may be better directed toward the operational pathways through which resources become services—teacher competence, staffing adequacy, implementation fidelity, and localized access support. Second, where data permit, capacity indicators (such as trained-teacher share) appear more tightly linked to exclusion outcomes than top-line fiscal ratios, reinforcing the management principle that “what is built and deployed” can matter more than “what is allocated.” Third, the descriptive disparities and uneven coverage highlight the need for stronger education data governance and monitoring systems across the region, particularly for countries with truncated or sparse reporting. Improved data continuity would not only strengthen research inference but also enhance evidence-based decision-making in ministries and local education offices.

Overall, the baseline panel model indicates that short-run shifts in education spending intensity do not yield precise ASEAN-wide estimates of exclusion reduction, while the sensitivity analysis suggests that system capacity—especially teacher training coverage—may be a more consistently relevant correlate when measurable. The descriptive trends reinforce that ASEAN exclusion dynamics are heterogeneous and, for several countries, shaped by volatility or limited data continuity, implying that leadership responses must be differentiated rather than uniform across the region.

4.6 Implications for Educational Leadership, Management, and Pedagogy

The results carry several practical implications for education leaders and system managers seeking to reduce primary-level exclusion in ASEAN contexts. First, the baseline TWFE findings indicate that aggregate education spending intensity (as a share of GDP) is not, by itself, a consistently precise predictor of short-run changes in primary out-of-school prevalence once country and year effects are controlled. For leadership practice, this implies that monitoring and accountability should not rely exclusively on “how much is spent,” but also on how spending is translated into operational access mechanisms. Leaders may therefore benefit from strengthening expenditure governance (e.g., budget execution discipline, targeting to access constraints, and transparent allocation rules), alongside monitoring of implementation bottlenecks that can prevent funding from generating measurable inclusion gains.

Second, the sensitivity specification highlights the potential relevance of instructional capacity as a more proximal system lever. The negative association between the share of trained primary teachers and out-of-school prevalence suggests that teacher competence and readiness may be closely aligned with inclusion outcomes, particularly in systems where capacity constraints and uneven service quality discourage attendance or retention. For leadership and management, this supports prioritizing capacity-building strategies such as sustained teacher professional development, credentialing and upskilling pathways, targeted deployment to underserved areas, and supervision routines that reinforce instructional practice and classroom management. In pedagogical terms, teacher preparedness is not merely a quality concern but also a participation concern, because effective instruction can improve learner engagement, reduce early discouragement, and support persistence among at-risk pupils.

Third, the descriptive country profiles and ASEAN-wide trends emphasize heterogeneity. Several systems display persistently higher levels of exclusion, while others remain near the lower bound of observed prevalence, and still others show volatility or data limitations. This pattern implies that ASEAN-wide leadership strategies should be differentiated by baseline conditions. For persistently higher-prevalence systems, leadership may need to integrate access-oriented interventions (e.g., reducing indirect schooling costs, strengthening school readiness

and local outreach, improving school-to-community linkages, addressing geographic and infrastructure barriers) with capacity-building and administrative reliability. For near-floor systems, the managerial emphasis may shift toward sustaining gains, strengthening early warning mechanisms for shocks, and preventing marginal exclusion from becoming entrenched among hard-to-reach subgroups.

Fourth, the observed sensitivity of estimates under sample restriction and uneven indicator coverage underscores the importance of education data governance as a leadership capability. From a management and policy standpoint, consistent and timely reporting of enrolment/exclusion indicators and system-capacity measures is essential for credible evaluation and informed decision-making. Leaders in ministries, local education offices, and school systems may therefore prioritize strengthening administrative data systems, ensuring methodological continuity, and institutionalizing routine monitoring. Improved continuity in reporting not only strengthens research inference but also supports operational accountability and rapid response during periods of disruption.

Taken together, these implications suggest that the leadership challenge is best framed as resource-to-service translation: budgets matter, but measurable inclusion improvements depend on how resources are operationalized into teacher capacity, school-level delivery, and access-focused interventions tailored to national context. The findings thus encourage education leaders to pair fiscal discussions with implementation metrics and capacity indicators, and to interpret cross-country comparisons through a differentiated, context-sensitive lens.

4.7 Limitations and Future Research Directions

This study has several limitations that should be considered when interpreting the results and deriving leadership or policy implications. First, the analysis relies on World Development Indicators (WDI) measures that are subject to uneven country-year coverage, particularly for system-capacity variables (e.g., pupil–teacher ratio and trained teachers). As shown by the restricted-sample sensitivity model, introducing additional controls can substantially reduce the usable panel and alter country composition across years. Consequently, coefficient shifts in the expanded-controls specification may reflect sample-selection and compositional effects rather than genuine structural differences in the underlying relationships across ASEAN education systems.

Second, the baseline model uses aggregate expenditure intensity (education spending as a percent of GDP) as the principal resource input. While this indicator is useful for cross-country comparability, it may not capture the efficiency, targeting, or execution quality of spending, nor the extent to which funds reach the specific bottlenecks that generate exclusion (e.g., last-mile access constraints, school readiness, local staffing, and retention supports). As a result, null or imprecise findings in the baseline model should not be interpreted as evidence that financing is irrelevant, but rather that broad expenditure intensity may be an insufficient proxy for the mechanisms through which leadership and management translate resources into inclusion outcomes.

Third, although the TWFE framework strengthens internal validity by controlling for time-invariant country characteristics and common year shocks, it is not a causal design in itself. The estimates should be interpreted as within-country associations over time, conditional on the model structure and available controls. Potential endogeneity remains possible—for example, expenditure may respond to exclusion pressures, and GDP per capita may proxy broader institutional or demographic dynamics not fully captured in the model. Additionally, the dependent variable reflects observed out-of-school prevalence and may be influenced by measurement discontinuities or reporting changes in some countries, which can appear as volatility in the trend profiles.

Fourth, the scope of inference is limited to the selected dependent variable—children out of school, primary (% of primary school age)—which captures one dimension of educational exclusion. Primary-level exclusion may respond differently to resource inputs than other outcomes such as completion rates, learning proficiency, or learning poverty. Thus, generalization to broader educational performance or learning outcomes should be made cautiously.

In light of these limitations, several directions for future research are recommended. Future studies may (a) extend the model to alternative dependent variables with stronger coverage, including completion and learning outcome measures, to assess whether spending and capacity indicators relate more strongly to quality- and learning-centered outcomes; (b) incorporate additional governance and delivery indicators—such as execution rates, decentralization measures, or equity-focused spending proxies—to better represent the resource-to-service translation mechanisms emphasized in leadership practice; and (c) pursue robustness checks using alternative panel estimators and lag structures where data availability permits, including specifications that explicitly test sensitivity to country composition and temporal coverage. Finally, future work may benefit from mixed-method extensions (e.g., comparative case profiling of high-burden vs. near-floor systems) to connect quantitative patterns to leadership decisions, administrative capacity, and pedagogical conditions that may not be fully observable in cross-country secondary datasets.

5. Conclusions and Recommendations

5.1 Conclusions

This study examined whether changes in public education spending intensity are associated with primary-level educational exclusion across ASEAN countries over time, using children out of school, primary (% of primary school age) as the dependent indicator and applying a two-way fixed effects (TWFE) panel regression framework. In the baseline model using 150 country-year observations across 10 ASEAN countries over 24 years, lagged education expenditure (as a percent of GDP) exhibited a negative coefficient consistent with the expected direction of policy logic; however, the estimate was not statistically precise under either clustered or heteroskedasticity-robust inference. This indicates that, within the observed ASEAN panel and under the current operationalization, short-run within-country changes in spending intensity did not yield sufficiently consistent evidence of measurable reductions in primary out-of-school prevalence after accounting for country and year effects.

A restricted-sample sensitivity analysis incorporating education-system capacity indicators produced a different pattern. In the coverage-limited panel, trained teachers in primary education showed a statistically significant negative association with primary out-of-school prevalence, supporting the interpretation that instructional capacity is plausibly aligned with lower exclusion in contexts where participation and retention are sensitive to schooling quality and delivery readiness. At the same time, coefficient sign changes—particularly the reversal of the spending coefficient—suggest that expanded-controls estimates are sensitive to uneven indicator coverage and country-year composition, and therefore should be treated as a robustness check rather than a definitive ASEAN-wide parameter.

Descriptive results and country trend profiles further demonstrate pronounced heterogeneity across ASEAN systems. Some countries exhibit persistently higher levels of primary exclusion relative to the regional distribution, while others remain near the lower bound of observed prevalence. Additional patterns of volatility or data limitations indicate that changes over time may reflect both real shifts in participation and discontinuities arising from reporting coverage or measurement practices. Taken together, the evidence suggests that reducing primary-level exclusion is not explained by expenditure intensity alone and is likely shaped by how resources are translated into operational access and instructional capacity within each national context.

5.2 Recommendations

Based on the findings and consistent with the study's descriptive-panel design, the following recommendations are offered for educational leadership, management, and pedagogy across ASEAN contexts:

1. Strengthen resource-to-service translation and expenditure governance. Education leaders should complement spending targets with implementation-focused management practices, including improved budget execution monitoring, transparent allocation rules, and program-level tracking that links expenditures to participation bottlenecks. This is essential because aggregate expenditure intensity may not reflect whether resources are reaching the specific constraints driving exclusion.
2. Prioritize instructional capacity-building as a participation strategy. Given the observed association between trained teachers and lower out-of-school prevalence in the restricted specification, education systems may strengthen teacher professional development, certification/upskilling pathways, school-level instructional supervision, and equitable deployment strategies—particularly in underserved areas. In practical terms, teacher competence and support should be framed not only as quality initiatives but also as retention and inclusion interventions.
3. Adopt differentiated strategies based on baseline exclusion conditions. Countries exhibiting persistently higher exclusion may prioritize access-centered interventions (e.g., community outreach, removal of indirect schooling costs, targeted support for vulnerable households, infrastructure and last-mile access solutions) alongside capacity-building and administrative reliability. Countries with near-floor prevalence may emphasize sustaining gains through early-warning monitoring, targeted support for hard-to-reach groups, and resilience planning during system shocks.
4. Improve education data continuity and indicator governance. Ministries and education agencies should strengthen administrative reporting systems and methodological continuity for key inclusion and capacity indicators, as uneven coverage constrains both research inference and evidence-based management. Institutionalizing routine monitoring and metadata documentation can reduce interpretive

ambiguity and improve comparability over time. Related analytics theory also emphasizes that data integration and analytic capability must translate into decision quality before they can produce measurable organizational outcomes, a logic that reinforces the need to connect education data systems with actionable management routines (Atento, Quinto, Espelita, & Castaneda, 2025).

5. Extend evaluation to outcomes beyond access. Future studies and internal monitoring systems should consider additional education outcomes—such as completion rates and learning measures—where data availability permits. This may clarify whether spending intensity is more strongly associated with learning quality and progression than with primary-level out-of-school prevalence alone.

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