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GOVERNANCE AND MACROECONOMIC DETERMINANTS OF ENVIRONMENTAL QUALITY IN MALAYSIA AND SINGAPORE: A CONCEPTUAL FRAMEWORK

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Abstract:

Environmental quality has become a major policy concern as developing and developed economies struggle to balance economic expansion with ecological sustainability. In Southeast Asia, Malaysia and Singapore provide a useful analytical setting because both countries are economically integrated and growth-oriented, yet differ institutional strength, regulatory enforcement, and environmental governance capacity. This conceptual paper develops a framework linking governance, economic growth, energy consumption, foreign direct investment, trade openness, and domestic investment to environmental quality, proxied by carbon dioxide emissions. This paper argues that governance is not only a direct determinant of environmental quality, but also other macroeconomic variables affect environmental outcomes. The Environmental Kuznets Curve and institutional governance perspectives are used to explain the expected relationships. This paper identifies a conceptual gap in the literature, namely the limited

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integration of governance with macroeconomic drivers of environmental quality in a comparative Southeast Asian setting. It proposes a framework in which strong governance can mitigate the environmentally harmful effects of growth, energy use, trade, and investment by improving regulation, enforcement, and policy coordination. This paper also contributes by offering a clearer theoretical basis for understanding environmental sustainability through institutional quality and by providing propositions that may guide future empirical work and policy design.

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Introduction

Environmental degradation has emerged as one of the most critical global challenges confronting in twenty-first century. Rising carbon emissions, increasing energy demand, and unsustainable production patterns continue to threaten ecological systems and human well-being. In rapidly developing regions, these pressures are intensified by industrialization, urbanization, and trade expansion. For Southeast Asian economies, environmental sustainability is no longer a peripheral issue, but a central development concern closely tied to long-term economic resilience and policy effectiveness. Recent studies continue to show that carbon emissions remain strongly connected to economic activity, energy dependence, trade integration, and institutional quality, making environmental quality a multidimensional development outcome rather than a purely ecological one (Gök & Sodhi, 2021; Ju et al., 2023; Pham & Nguyen, 2024).

Besides, in Southeast Asia, this issue is particularly important because countries are simultaneously pursuing economic competitiveness and climate commitments. Malaysia has maintained formal climate commitments, including an updated nationally determined contribution that targets a 45% reduction in greenhouse-gas emissions intensity relative to GDP by 2030 compared with 2005 levels (UNFCCC, 2021). Singapore's Green Plan 2030 similarly forms part of its whole-of-nation sustainable-development agenda, alongside its commitment to reduce emissions to around 60 MtCO₂e by 2030 and achieve net zero by 2050 (NCCS, 2026; Singapore Green Plan, 2026). These policy commitments indicate that environmental quality is no longer a peripheral concern, but a central development priority in both countries.

Malaysia and Singapore provide an important setting for conceptual analysis because both countries are highly integrated into the regional and global economy yet differ significantly in their stages of development and institutional strength. According to Transparency International Corruptions Index (CPI) 2024, Singapore scored 84 out of 100 and ranked 3rd out of 180 countries, implying a very high level of perceived public sector integrity. In contrast, Malaysia recorded a score of 50 and ranked 57th out of 180 nations, reflecting a more moderate governance standing and suggesting comparatively greater institutional and enforcement challenges (Transparency International, 2025). This disparity suggests that Singapore possess stronger governance quality than Malaysia, thus reinforcing the relevance of both countries in analysing the governance-environment nexus.

Although a growing body of literature examines the effects of growth, trade, FDI, and energy consumption on environmental quality, much of it remains fragmented. In many studies, governance is treated only as a control variable, despite strong evidence that institutional quality can directly reduce emissions and moderate the adverse effects of economic expansion, trade openness, and investment inflows (Ju et al., 2023; Aydin et al., 2024). This suggests the need for a more integrated conceptual approach that places governance at the centre of environmental analysis.

Accordingly, this paper aims to develop a conceptual framework on the nexus between governance and macroeconomic determinants of environmental quality in Malaysia and Singapore. Rather than estimating relationships empirically, the paper synthesizes theory and recent literature to clarify the role of governance in shaping environmental outcomes. The paper is structured into theoretical background, conceptual analysis, conceptual gap, proposed framework, research propositions, policy implications, and conclusion.

Theoretical Background

Environmental quality generally refers to the condition of natural systems in sustaining ecological balance and human well-being. In macro-level environmental analysis, carbon dioxide emissions are widely used as a proxy because they reflect the environmental consequences of energy use, industrial production, transport intensity, and investment-driven growth. This remains standard in recent work on environmental sustainability in developing and emerging economies (Pham & Nguyen, 2024; Aydin et al., 2024).

A central theoretical lens for this paper is the Environmental Kuznets Curve (EKC). The EKC proposes that environmental degradation tends to rise during the early stages of development, when industrialization and fossil-fuel dependence intensify, but may eventually decline after higher income levels are reached and cleaner technology, stricter regulation, and less pollution-intensive production structures emerge (Grossman & Krueger, 1995; Panayotou, 1993). Later scholarship suggests that this transition is influenced not only by income growth, but also by institutional conditions and policy quality. Recent evidence from the European Union, for example, indicates that institutional quality and environmental technologies significantly improve environmental sustainability, supporting the view that macroeconomic change alone is insufficient to explain environmental outcomes (Aydin et al., 2024).

From a governance-theory perspective, governance is understood as a broader process than formal government alone. Rather than viewing public outcomes as produced solely through state authority, governance theory emphasizes the ways in which public institutions, private

actors, and wider societal stakeholders interact in the steering of collective affairs. In one of the most widely cited formulations, Stoker (1998) explains governance through five propositions, including the idea that governance involves a wider set of institutions and actors beyond government, blurs boundaries of responsibility for social and economic issues, and depends on interdependence among actors in addressing complex public problems. This understanding is relevant to the present paper because environmental quality is not shaped only by market forces or economic expansion, but also by the quality of institutional coordination, regulatory capacity, and public accountability that structure environmental decision-making. In a similar vein, the World Bank (1992) defines governance as the manner in which power is exercised in the management of a country's economic and social resources for development, highlighting the importance of institutions, rules, and administrative effectiveness in shaping development outcomes.

In addition, governance-network theory provides a useful extension for explaining why governance matters in environmental analysis. Klijn (2008) argues that governance increasingly occurs through networks of relatively interdependent actors who must coordinate to solve complex societal problems that cannot be managed effectively through hierarchical state control alone. Environmental issues such as carbon emissions, energy transition, trade-related pollution, and investment-led industrial expansion are classic examples of such complex problems because they involve multiple institutions, sectors, and policy domains. Accordingly, the governance perspective used in this paper views governance as an institutional and regulatory capacity that influences how effectively a country manages macroeconomic activity in ways that protect environmental quality. This theoretical lens strengthens the argument that environmental outcomes should be analysed not only through economic determinants, but also through the broader quality of governance that shapes enforcement, coordination, and policy implementation (Klijn, 2008; Stoker, 1998; World Bank, 1992).

Moreover, the environmental-governance perspective complements the EKC by emphasizing the role of institutional effectiveness, regulatory enforcement, accountability, and corruption control. Stronger governance can improve environmental quality by ensuring compliance with environmental standards and reducing the institutional weaknesses that permit environmentally harmful activity. Gök and Sodhi (2021) found that governance materially affects environmental quality across countries, while Ju et al. (2023) showed that good governance contributes to lower environmental degradation in Arab countries. Together, these perspectives suggest that environmental quality should be analyzed as the outcome of both macroeconomic dynamics and institutional capacity.

Conceptual Analysis

Firstly, governance is conceptually important because environmental quality depends partly on the ability of institutions to regulate harmful activity. Better governance can improve environmental quality through stronger enforcement, more coherent regulation, reduced corruption, and improved policy coordination. This interpretation is consistent with Basumatary et al. (2024), who found that governance reduces carbon dioxide emissions in Asian countries. It is also supported by broader evidence showing that governance generally promotes environmental sustainability or reduces environmental degradation, although the magnitude and direction of the relationship may vary across country groups and development levels (Abid et al., 2023; Gök & Sodhi, 2021; Gyamfi et al., 2023; Pujiati et al., 2023). This variation suggests that governance should not be treated as a uniform institutional force, since

different studies operationalize governance differently, including corruption control, institutional quality, regulatory effectiveness, and broader state capacity. As a result, inconsistencies in the literature may arise not because governance is irrelevant, but because different dimensions of governance are being examined under different political and economic settings.

Next, economic growth is another key determinant of environmental quality. In many economies, growth increases environmental pressure through industrial expansion, urbanization, transport demand, and energy use. However, the Environmental Kuznets Curve (EKC) suggests that the growth effect may weaken or reverse when economies transition toward cleaner technologies, stronger regulation, and more sustainable production structures. Pujiati et al. (2023), for example, reported that economic growth in Indonesia increased environmental degradation, which is consistent with evidence from West African countries and the European context showing that growth may initially worsen environmental quality before institutional and technological improvements begin to offset environmental damage (Abid et al., 2023; Aydin et al., 2024). This contradiction across studies is largely explained by differences in development stage, industrial structure, technological progress, and regulatory maturity. Therefore, the growth–environment relationship should not be interpreted as fixed, but as conditional on how growth is generated and managed.

Besides, energy consumption has a direct environmental effect because fossil-fuel-based systems generally produce higher emissions. Gyamfi et al. (2023) demonstrated that energy consumption increases carbon emissions and reduces environmental quality in Malaysia. Similarly, Pujiati et al. (2023) and Abid et al. (2023) also found a positive relationship between energy use and environmental degradation. Compared with other variables, this relationship is more consistent in the literature because energy consumption remains closely tied to fossil-fuel dependence in many economies. However, the effect is not entirely uniform. In countries with better energy efficiency, cleaner technologies, and a more diversified energy mix, the environmental impact of rising energy use may be reduced. Conceptually, this suggests that the environmental effect of energy use depends not only on the volume of energy consumed, but also on energy composition, technological efficiency, and policy orientation.

Nevertheless, foreign direct investment has an ambiguous environmental effect. It may worsen environmental quality when it enters pollution-intensive sectors, especially in countries with weak regulatory enforcement, but it may improve environmental quality when it brings cleaner technology, higher standards, and more efficient production practices. Recent evidence supports both possibilities. Ju et al. (2023) found that FDI can reduce environmental degradation when combined with good governance and technological progress, while Pham and Nguyen (2024) reported that FDI worsens environmental quality in 64 developing countries. Likewise, Pujiati et al. (2023) and Duodu et al. (2021) found that FDI may improve environmental quality in Indonesia and Sub-Saharan Africa under certain institutional and policy conditions, whereas Gyamfi et al. (2023) showed that FDI increases environmental degradation in Malaysia. These contradictions occur because the environmental effect of FDI depends on the sectoral destination of investment, the stringency of environmental regulation, the technological content of inflows, and the development priorities of the host country. Thus, FDI should not be assumed to be either inherently harmful or inherently beneficial to environmental quality.

Furthermore, trade openness can raise emissions through greater production intensity, export expansion, and transport activity, but it can also support cleaner outcomes through technology transfer, access to environmentally efficient goods, and competitive pressure toward improved production methods. Pham and Nguyen (2024) found no statistically significant overall effect of trade openness on environmental pollution across 64 developing countries, while still reporting weak support for the pollution-haven argument. However, Abid et al. (2023) and Gyamfi et al. (2023) found that trade openness in West Africa and Malaysia worsened environmental quality. These conflicting findings indicate that the environmental consequences of trade openness are highly context-dependent. The contradictions may be explained by differences in export structure, industrial specialization, environmental standards, and the extent to which trade is associated with dirty production or cleaner technological diffusion. Therefore, trade openness should be understood as a transmission mechanism whose environmental effect depends on the nature of traded goods and the institutional conditions governing trade-related production.

Meanwhile, domestic investment should likewise be treated as a direct determinant of environmental quality because it reflects the allocation of capital within the national economy. Investment directed toward heavy industry, construction, logistics, and carbon-intensive infrastructure can increase emissions, whereas investment in renewable energy, green technology, and sustainable infrastructure can improve environmental outcomes. Duodu et al. (2021) found that domestic investment improved environmental quality in Sub-Saharan Africa, while Dhiif and Ali (2025) reported that domestic investment reduced CO₂ emissions in Somalia, suggesting that investment can enhance environmental quality when it supports sustainable practices. In contrast, Evans (2024) found that domestic investment increased CO₂ emissions in the United States and Canada, indicating that capital accumulation may worsen environmental quality when it expands energy-intensive production and infrastructure. These inconsistent findings suggest that domestic investment is not environmentally neutral. Its impact depends on the sectoral allocation of capital, the technological orientation of investment, and whether national development planning prioritizes sustainable or conventional carbon-intensive activities.

Taken together, the literature reveals that the relationships between governance, macroeconomic determinants, and environmental quality are not uniform across countries or regions. Contradictions across studies arise for several reasons. First, countries differ in development level, industrial structure, institutional maturity, and technological capability, all of which influence how economic variables affect the environment. Second, studies use different proxies for governance, investment, trade openness, and environmental quality, which may produce different empirical outcomes even when examining similar issues. Third, methodological differences, including data period, econometric techniques, and country coverage, also contribute to variation in findings. These contradictions do not weaken the importance of the variables themselves; instead, they indicate that the environmental consequences of macroeconomic activity are highly context-specific.

In this regard, the conceptual framework proposed in this study helps resolve these inconsistencies by integrating governance, economic growth, energy consumption, foreign direct investment, trade openness, and domestic investment within a single direct-effects framework. Rather than examining each determinant in isolation, the framework recognizes that environmental quality is shaped by the combined influence of institutional and macroeconomic forces. This is important because contradictory findings often emerge when

one variable is analysed without adequate consideration of the wider structural and institutional context in which it operates. By positioning governance and the selected macroeconomic determinants as parallel explanatory variables affecting environmental quality, the framework provides a clearer and more coherent basis for understanding why similar determinants may produce different environmental outcomes across countries. For Malaysia and Singapore in particular, this integrated framework is highly relevant because both countries are economically open and development-oriented, yet differ in governance capacity, institutional strength, regulatory quality, and economic structure. Therefore, the framework offers a stronger conceptual basis for explaining variation in environmental quality while also addressing the fragmentation and contradiction that characterize much of the existing literature.

Conceptual Gap

The existing literature has established that environmental quality is influenced by a number of macroeconomic and institutional factors. A substantial body of research shows that economic growth, energy consumption, foreign direct investment, trade openness, and governance are all associated with environmental outcomes, particularly carbon dioxide emissions. Prior studies have also shown that these relationships are not always linear or uniform. For example, the Environmental Kuznets Curve literature suggests that economic growth may initially worsen environmental quality before cleaner technology, structural transformation, and stronger regulation begin to reduce environmental degradation. Similarly, research on governance generally supports the view that stronger institutions, better regulatory quality, and lower corruption can improve environmental sustainability, while studies on foreign direct investment, trade openness, and domestic investment report both environmentally harmful and beneficial effects depending on country context, policy setting, and sectoral composition (Abid et al., 2023; Aydin et al., 2024; Basumatary et al., 2024; Gök & Sodhi, 2021; Ju et al., 2023; Pham & Nguyen, 2024; Pujiati et al., 2023).

However, what remains insufficiently developed is a coherent conceptual explanation that integrates these determinants within a single framework. Much of the existing literature examines the variables separately through distinct analytical lenses, such as the growth and environment nexus, the energy and emissions relationship, the pollution haven hypothesis, or the trade–environment linkage. As a result, the literature provides useful but partial explanations of environmental quality. Governance is frequently included only as a control variable or background institutional factor, despite growing evidence that it plays a substantive role in shaping environmental outcomes through enforcement capacity, regulatory effectiveness, corruption control, and policy coordination. Likewise, domestic investment remains underdeveloped in environmental-quality frameworks, even though national capital allocation into infrastructure, industry, logistics, energy systems, and green technology can significantly influence emissions trajectories. This means that the literature is richer in isolated empirical findings than in integrated conceptual understanding.

The problem is compounded by contradiction across studies. The conceptual analysis above shows that governance, foreign direct investment, trade openness, and domestic investment do not produce consistent environmental effects across contexts. These inconsistencies arise because countries differ in development level, institutional maturity, industrial structure, technological capability, and policy orientation. They also arise because studies use different indicators, sample periods, and estimation approaches. Consequently, the current literature does not sufficiently explain why the same determinant may reduce environmental degradation

in one setting but worsen it in another. In other words, what is known is that these variables matter; what remains unknown is how they should be conceptually understood together, and why their effects vary systematically across institutional and developmental contexts.

This unresolved gap matters for both theory and policy. Theoretically, without an integrated framework, environmental quality risks being explained in a fragmented way that underestimates the interaction between macroeconomic forces and institutional capacity. Policymaking is also weakened when growth, trade, investment, energy use, and governance are treated as separate issues rather than as interconnected drivers of environmental outcomes. This is particularly important in the cases of Malaysia and Singapore, where both countries are highly integrated into regional and global markets but differ substantially in governance capacity, regulatory strength, and development structure. These differences make them analytically valuable for conceptual work because they allow the study to move beyond generic claims and to frame environmental quality as the outcome of multiple direct determinants operating under different institutional conditions.

Therefore, this study addresses the conceptual gap by proposing an integrated direct-effects framework in which governance, economic growth, energy consumption, foreign direct investment, trade openness, and domestic investment are positioned as key determinants of environmental quality, proxied by carbon dioxide emissions. Rather than treating governance as a peripheral control or examining each macroeconomic determinant in isolation, the framework brings them together within a single conceptual structure. In doing so, the study provides a clearer basis for explaining variation in environmental quality and offers a more coherent foundation for future empirical research on Malaysia, Singapore, and comparable economies.

Conceptual Framework

The proposed conceptual framework is developed from the Environmental Kuznets Curve and institutional governance perspectives. The Environmental Kuznets Curve explains how economic growth may initially increase environmental degradation through industrialisation, urbanisation, energy demand, and production expansion, before environmental pressure declines at higher levels of development due to cleaner technology, structural transformation, and stronger environmental regulation (Grossman & Krueger, 1995; Panayotou, 1993). However, the EKC alone is insufficient because economic growth does not automatically lead to environmental improvement. The quality of governance, policy enforcement, and institutional capacity determines whether economic development becomes environmentally harmful or environmentally sustainable.

In this framework exhibit in Figure 1, environmental quality is positioned as the dependent variable and is proxied by carbon dioxide emissions. This proxy is appropriate because CO₂ emissions reflect the environmental consequences of energy consumption, industrial production, transport activity, investment expansion, and trade-related economic activities. The use of CO₂ emissions as a proxy is consistent with recent environmental sustainability studies and with the structure of this study.

Firstly, governance is included as the institutional determinant of environmental quality. Strong governance is expected to improve environmental quality by strengthening environmental regulation, improving enforcement capacity, reducing corruption, increasing policy

transparency, and ensuring better coordination of sustainable development strategies. In this sense, governance is not merely a background condition but a direct explanatory factor that influences the effectiveness of environmental management. This argument is supported by studies showing that institutional quality and good governance can reduce environmental degradation and improve sustainability outcomes (Aydin et al., 2024; Gök & Sodhi, 2021; Ju et al., 2023). Therefore, the expected directional relationship is negative between governance and CO2 emissions, and positive between governance and environmental quality.

Secondly, economic growth is included because expansion in output, income, industrial activity, and consumption may increase environmental pressure, especially when growth depends on fossil-fuel energy and resource-intensive production. However, consistent with the EKC perspective, economic growth may also support environmental improvement when it enables technological upgrading, cleaner production, and stricter regulation. Therefore, the expected relationship between economic growth and environmental quality is theoretically ambiguous. In lower stages of development, economic growth is expected to have a positive relationship with CO2 emissions and a negative relationship with environmental quality. In contrast, in more advanced stages of development, economic growth may have a negative relationship with CO2 emissions and a positive relationship with environmental quality.

Thirdly, energy consumption is treated as a major macroeconomic determinant because fossil-fuel-based energy use is one of the most direct contributors to CO2 emissions. Higher energy consumption tends to worsen environmental quality when energy systems depend heavily on coal, oil, or natural gas. Although this effect may be reduced when countries improve energy efficiency or shift toward renewable energy sources, the dominant expectation in the literature remains that greater energy use raises emissions. Thus, the expected directional relationship is positive between energy consumption and CO2 emissions, and negative between energy consumption and environmental quality, although the strength of the relationship may vary according to the composition and efficiency of the energy system.

Fourth, foreign direct investment (FDI) is also included because it can affect environmental quality through two opposing channels. Under the pollution haven hypothesis, FDI may worsen environmental quality when multinational firms invest in pollution-intensive sectors or when host countries have weak environmental regulations. In contrast, under the pollution halo hypothesis, FDI may improve environmental quality by transferring cleaner technologies, better management practices, and more efficient production systems. Therefore, the expected relationship is ambiguous. FDI may have a positive relationship with CO2 emissions and a negative relationship with environmental quality when it promotes carbon-intensive production, but it may also have a negative relationship with CO2 emissions and a positive relationship with environmental quality when it supports cleaner production and sustainable investment.

Fifth, trade openness is incorporated because greater international trade may increase production, transport activities, and resource use, thereby raising CO2 emissions. However, trade openness may also improve environmental quality if it facilitates access to cleaner technologies, environmentally friendly goods, and higher production standards. The relationship is therefore theoretically ambiguous. Trade openness may have a positive relationship with CO2 emissions and a negative relationship with environmental quality when trade is associated with pollution-intensive exports and carbon-intensive production. Conversely, it may have a negative relationship with CO2 emissions and a positive relationship

with environmental quality when trade enhances technological diffusion, efficiency gains, and cleaner production processes.

Lastly, domestic investment is included as a separate determinant because it captures the role of internal capital formation in shaping environmental outcomes. Investment in construction, heavy industry, logistics, and carbon-intensive infrastructure may increase emissions and reduce environmental quality. Conversely, investment in renewable energy, green infrastructure, public transport, energy efficiency, and sustainable technology may reduce emissions and improve environmental quality. Recent evidence supports this mixed effect, with Dhiif and Ali (2025) showing that domestic investment can reduce CO₂ emissions, while Evans (2024) found that domestic investment can increase CO₂ emissions when linked to energy-intensive growth. Therefore, the expected relationship between domestic investment and environmental quality is ambiguous. Domestic investment may have either a positive or negative relationship with CO₂ emissions, depending on the sectoral allocation and environmental orientation of capital formation.

Overall, the conceptual framework proposes that environmental quality in Malaysia and Singapore is shaped by the combined influence of one institutional factor and five macroeconomic factors. Governance represents the institutional factor, while economic growth, energy consumption, foreign direct investment, trade openness, and domestic investment represent the macroeconomic determinants. Each variable is expected to exert a direct effect on environmental quality. More specifically, governance is expected to reduce CO₂ emissions, energy consumption is expected to increase CO₂ emissions, while economic growth, foreign direct investment, trade openness, and domestic investment are expected to have context-dependent or ambiguous effects. This direct-effects framework is more suitable for the objective of the paper because it avoids overstating governance as a mediating or moderating variable and instead positions all explanatory variables as direct determinants of CO₂ emissions.

Based on the conceptual framework in Figure 1, the following directional propositions are proposed:

P1: Governance has a negative relationship with CO₂ emissions and a positive relationship with environmental quality.

P2: Economic growth has an ambiguous relationship with CO₂ emissions and environmental quality; it may increase CO₂ emissions in earlier stages of development but reduce CO₂ emissions in more advanced stages.

P3: Energy consumption has a positive relationship with CO₂ emissions and a negative relationship with environmental quality.

P4: Foreign direct investment has an ambiguous relationship with CO₂ emissions and environmental quality; it may either increase or reduce emissions depending on sectoral destination, technology transfer, and regulatory quality.

P5: Trade openness has an ambiguous relationship with CO₂ emissions and environmental quality; it may either worsen or improve environmental outcomes depending on trade structure, production intensity, and environmental regulation.

P6: Domestic investment has an ambiguous relationship with CO2 emissions and environmental quality; it may worsen environmental quality when directed toward carbon-intensive sectors but improve environmental quality when channelled into green and sustainable sectors.

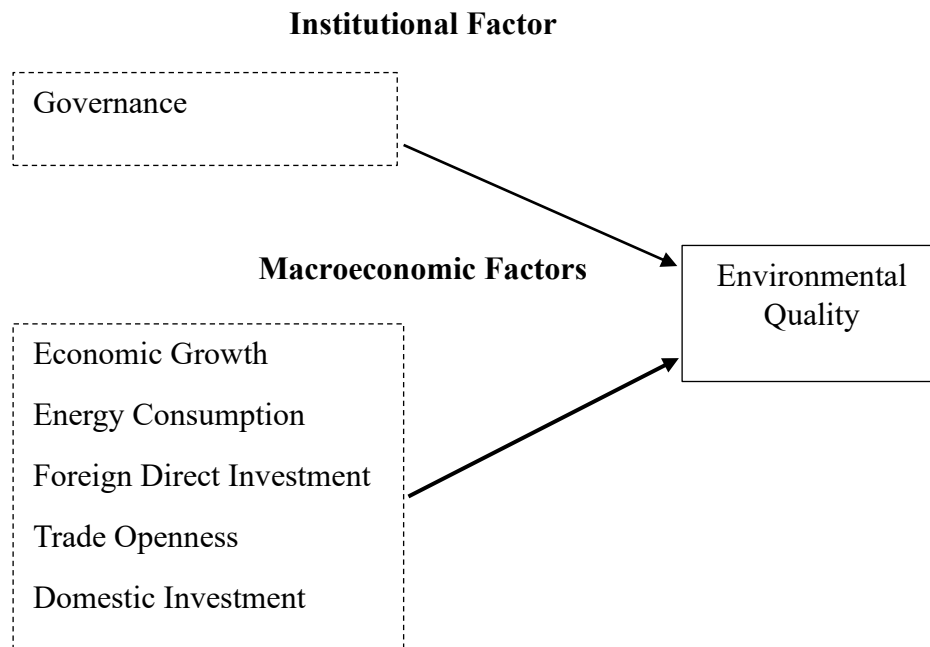


Figure 1: Environmental Quality Conceptual Framework

Policy Implications

The policy implication of this conceptual framework is that environmental sustainability cannot be addressed through isolated interventions. Since environmental quality is shaped by governance, economic growth, energy consumption, foreign direct investment, trade openness, and domestic investment simultaneously, policy design must move beyond fragmented measures and adopt a more coordinated development strategy. In particular, the findings of the broader literature suggest that institutional quality, technological upgrading, regulatory consistency, and targeted investment allocation are more likely to improve environmental outcomes when pursued as mutually reinforcing policy domains rather than as separate agendas.

For Malaysia, the main policy priority lies in improving implementation capacity within environmental governance. The issue is not simply the absence of policy direction, but the persistence of enforcement gaps, uneven regulatory compliance, and the continued expansion of carbon-intensive production and investment activities. As such, policy reform should focus on strengthening enforcement mechanisms in emissions-intensive sectors, improving transparency in environmental monitoring and reporting, and integrating environmental criteria more systematically into industrial promotion and investment approval processes. This is particularly important in the context of trade and investment expansion, where environmental safeguards need to be embedded more directly into production policy, export-oriented

industrialisation, and project evaluation so that economic growth does not continue to generate disproportionate environmental costs.

For Singapore, the policy challenge is different and concerns the deepening of low-carbon transition tools within an already strong institutional setting. Rather than basic regulatory strengthening, the emphasis should be placed on aligning capital accumulation and continued economic expansion with more advanced decarbonisation strategies. This includes the wider use of carbon pricing as a transition signal, the expansion of sustainable and transition finance instruments, stronger climate-related disclosure standards, and more targeted support for energy efficiency, industrial innovation, and low-carbon infrastructure. In this sense, the Singapore case highlights that strong governance alone is insufficient unless financial regulation, investment allocation, and technological upgrading are systematically directed toward emissions reduction.

More broadly, the comparative implication for both countries is that environmental quality depends not only on the scale of macroeconomic activity, but on the institutional and policy mechanisms through which such activity is governed. Malaysia and Singapore therefore illustrate two distinct but complementary reform pathways: Malaysia underscores the importance of enforcement-centred regulatory upgrading, while Singapore demonstrates the importance of finance-led and innovation-driven transition management. The wider policy lesson is that sustainable environmental outcomes require governance systems that are capable not only of controlling environmentally harmful activity, but also of redirecting growth, trade, and investment toward lower-carbon development trajectories.

Conclusions

This conceptual paper clarifies and strengthens the theoretical basis for understanding environmental quality in Malaysia and Singapore by aligning the framework with the actual study objective. Governance is treated as one explanatory variable alongside economic growth, energy consumption, foreign direct investment, trade openness, and domestic investment, with all six factors directly affecting environmental quality. This provides a more accurate and analytically coherent approach than frameworks that overstate governance as an intervening construct.

The paper makes three main contributions. First, it addresses conceptual fragmentation in the literature by integrating governance and major macroeconomic determinants within a single direct-effects framework. Second, it grounds that framework in both foundational theory and recent evidence, showing that environmental quality is shaped by the combined influence of structural economic change and institutional capacity. Third, it generates policy-relevant insight by showing that environmental sustainability in open, development-driven economies depends not only on the pattern of growth itself, but also on how that growth is governed, financed, and supported by the energy system.

Taken together, the analysis suggests that environmental quality in Malaysia and Singapore should be understood as the outcome of a multidimensional process. Stronger governance alone is not sufficient if trade, investment, and energy systems remain carbon intensive. Likewise, economic modernisation alone is not sufficient if institutional quality fails to ensure environmental compliance and long-term policy coherence. The broader conclusion, therefore,

is that sustainable environmental outcomes require institutional capability and macroeconomic transformation to move in the same direction.

Nevertheless, this paper is not without limitations. As a conceptual study, it does not empirically test the proposed relationships and therefore cannot establish the magnitude, direction, or statistical significance of the effects discussed. In addition, environmental quality is represented only by carbon dioxide emissions, which, although widely used in the literature, do not capture other important dimensions of environmental degradation such as biodiversity loss, deforestation, waste generation, or water and air quality more broadly. The framework is also developed specifically around Malaysia and Singapore, meaning that its explanatory relevance may not be directly transferable to countries with different institutional structures, development trajectories, or sectoral compositions. Furthermore, although governance is treated as a central institutional determinant, governance itself is multidimensional and may be measured differently across studies, which can produce variation in interpretation and application.

These limitations, however, do not diminish the value of the study; rather, they define the boundary of its contribution. The framework offered here should therefore be understood as a foundation for future empirical work rather than a final explanation of environmental outcomes. Future studies may extend this framework by testing the proposed relationships econometrically, incorporating broader environmental indicators, examining additional governance dimensions, and comparing a wider range of countries. In this sense, the present paper provides a firmer conceptual basis for future empirical investigation and a clearer policy logic for countries attempting to balance economic development with environmental sustainability.

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