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MONETARY AND ENVIRONMENTAL POLICY INTERACTIONS IN MALAYSIA: IMPLICATION FOR TRADE

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ABSTRACT

This study examines the interactions between monetary and environmental policies in Malaysia and their combined impact on sustainable trade. Drawing on Ecological Modernization Theory (EMT), the research investigates whether macroeconomic tools such as interest rates and inflation can be effectively coordinated with environmental indicators like carbon emissions to promote trade openness. Using annual time-series data from 1990 to 2020 and applying the Autoregressive Distributed Lag (ARDL) approach, the study estimates both short-run and long-run relationships among trade openness, monetary variables (interest rate and inflation), macroeconomic indicators (GDP per capita and exchange rate), and environmental performance (CO_2 emissions). The results reveal the existence of a stable long-run cointegration relationship among the variables. In the long run, inflation is found to significantly reduce trade openness, whereas exchange rate depreciation and economic growth enhance trade integration. Moreover, CO_2 emissions exert a negative and statistically significant effect on trade openness, demonstrating that environmental sustainability has emerged as a critical determinant of international competitiveness. Short-run dynamics indicate that inflation and economic growth have immediate effects on trade activity, while environmental impacts operate primarily through long-term structural channels. The findings also highlight that trade openness, although beneficial for economic expansion, is associated with increased environmental pressure. These outcomes emphasize the importance of integrated policy mechanisms to balance economic competitiveness with environmental sustainability. By extending EMT to include monetary dimensions, this study contributes to a more holistic understanding of sustainable development policy and offers actionable insights for policymakers navigating Malaysia's transition toward a low-carbon economy.

INTRODUCTION

Global economic integration has intensified rapidly in recent decades. This shift has reshaped international trade patterns, capital flows, and global production networks. In 2022, global trade in goods and services surpassed USD 32 trillion, while foreign direct investment (FDI) inflows reached about USD 1.3 trillion (UNCTAD, 2023). These developments have supported growth and technology diffusion. However, they have also contributed to rising environmental pressures. Global carbon dioxide emissions were estimated at 37 billion tonnes in 2023, illustrating the ongoing reliance on carbon-intensive activities (IEA, 2023).

Policymakers face a core challenge in sustaining economic expansion while ensuring environmental protection. This challenge is especially evident in emerging and developing economies. Many of these countries rely on export-driven and energy-intensive industries for growth (Khan et al., 2019). They must remain competitive in global markets while shifting toward low-carbon development pathways. Achieving this balance requires stronger coordination between macroeconomic and environmental policies. Monetary policy influences financing conditions, investment behaviour, and exchange rates. Environmental policy shapes production decisions, firm competitiveness, and trade patterns through regulations and market-based tools. Although these areas are closely linked, they are often studied separately. As a result, evidence on how monetary policy and environmental policy interact, particularly in open economies remains limited.

Recent research highlights the growing macroeconomic importance of climate-related policies. Environmental regulation can create transition risks, but it may also enhance productivity when designed effectively (De Santis et al., 2021; Kahn et al., 2021). However, empirical studies on the combined effects of monetary and environmental policies are still scarce. Most works examine either monetary policy's impact on inflation and output or environmental policy's effects on emissions and innovation. Few explore how these policies jointly influence trade performance and investment flows. This gap is significant for export-oriented emerging economies, where climate policies can shift comparative advantage and affect cross-border capital movement.

Malaysia offers a relevant case for examining these interactions. It is one of Southeast Asia's most open economies and remains a major exporter within the ASEAN region (Othman et al., 2022). Its key industries which included palm oil, manufacturing, and energy are central to export earnings but also major sources of carbon emissions and environmental stress (Shaari et al., 2022). Malaysia has strengthened its sustainability agenda through national development plans and alignment with the United Nations Sustainable Development Goals, especially SDG 8 and SDG 13 (Khalila, 2024). Recent initiatives, such as the National Energy Transition Roadmap and the introduction of carbon pricing mechanisms, mark a shift toward a low-carbon economic model.

Despite these advances, research on Malaysia's monetary and environmental policy link remains limited. Existing studies tend to evaluate each policy domain separately and provide only partial insights. This study addresses this gap by examining how monetary policy, environmental policy, and trade interact over time. It draws on an integrated empirical approach to contribute to three key areas which are the monetary policy transmission in open economies, climate and environmental policy effectiveness, and trade and investment behaviour in emerging markets.

The findings aim to guide policymakers in designing more coherent policies. Stronger alignment between monetary and environmental strategies can enhance sustainable trade competitiveness and attract greener investment flows. Malaysia's experience also offers lessons for other economies seeking to balance growth ambitions with environmental constraints.

PROBLEM STATEMENT

Malaysia's economic growth has been built on an export-oriented development model supported by its strategic location, diversified industrial base, and natural resources. While this strategy has delivered sustained growth and investment inflows, it

has also reinforced dependence on fossil fuels, land-intensive agriculture, and emission-heavy manufacturing. As a result, environmental pressures have intensified, including deforestation, rising industrial emissions, and biodiversity loss (Ahmed et al., 2019; Khan et al., 2019). These pressures now present direct economic risks by weakening ecological stability, public health, and long-term productivity.

Concurrently, the global trading system is shifting toward sustainability-based governance. Major trading partners are embedding climate objectives into trade and investment policies. The European Union's Carbon Border Adjustment Mechanism and deforestation-free regulations are redefining market access for exporters from carbon-intensive economies (Othman et al., 2022). Japan, a key Malaysian trade partner, has also strengthened its green investment agenda through the use of environmental, social, and governance (ESG) criteria. These developments increase exposure to trade frictions and investment diversion for economies that fail to align domestic policies with evolving sustainability standards.

From a theoretical perspective, Ecological Modernization Theory (EMT) posits that economic growth and environmental improvement can be mutually reinforcing through technological upgrading and structural transformation (Nurgazina et al., 2021). However, progress is contingent on institutional capacity and policy design, which remain uneven in emerging economies. Moreover, EMT-based research has largely overlooked the role of macroeconomic policy, particularly monetary policy which shapes financing conditions, credit allocation, and investment direction. This omission limits the framework's relevance in open economies where capital flows and financial conditions critically influence sustainability outcomes.

This gap is especially crucial for Malaysia as a highly open economy with carbon-intensive export sectors. Uncoordinated policy may prolong investment in high-emission industries or impose growth constraints through poorly sequenced regulation. This study examines the interaction between monetary and environmental policy in shaping Malaysia's trade performance. By integrating monetary policy into the EMT framework, it advances theory and provides policy-relevant insights into sustaining competitiveness under environmental constraint.

RESEARCH OBJECTIVE

This study examines how monetary and environmental policies, individually and jointly, influence trade openness in Malaysia. It analyses the effects of monetary conditions such as interest rates and inflation on trade performance, while assessing how environmental policies affect export competitiveness and market access. Using an integrated framework, the study identifies both short- and long-run policy interactions and evaluates whether environmental policy and monetary policy alter trade openness. The findings aim to inform coherent policy design to strengthen trade resilience and support sustainable competitiveness.

LITERATURE REVIEW

Monetary policy is traditionally viewed as a tool for maintaining price stability and supporting economic growth. However, recent studies show that it is not environmentally neutral (A'yun & Khasanah, 2022; Hu et al., 2023). Central bank decisions influence the allocation of capital between carbon-intensive and green sectors through interest rates, liquidity conditions, and financial signalling. As a result, monetary policy indirectly shapes energy use, investment patterns, and environmental outcomes (Tran & Do, 2021). This challenges the conventional view of monetary neutrality and highlights the need for an integrated macro-financial-environmental perspective.

Expansionary monetary conditions can stimulate trade and investment but may also encourage pollution-intensive production if environmental safeguards are weak (Hu et al., 2023). Conversely, tight financial conditions may constrain both green and carbon-intensive investment, raising concerns about policy trade-offs between environmental objectives and economic growth.

Trade openness is widely recognised as a driver of growth but also a source of environmental stress. Evidence from ASEAN economies shows that higher exports, GDP, and foreign investment are associated with increased emissions, supporting the "scale effect" hypothesis (A'yun & Khasanah, 2022). Similarly, Tran and Do (2021) find that trade liberalisation worsens environmental quality where regulation is weak. These effects may be amplified under accommodative monetary conditions that facilitate capital-intensive production.

Growing international emphasis on environmental standards is reshaping global trade. Carbon border measures, sustainability reporting, and green supply chains increasingly determine market access (Brandi et al., 2020; Othman et al., 2022). In Malaysia, reforms in environmental governance have reduced exposure to ecological risks and enhanced the country's appeal to sustainability-focused investors (Hamzah et al., 2019). Ling et al. (2020) further show that ESG frameworks now play a central role in foreign investment decisions, favouring economies with credible environmental institutions.

Despite these insights, existing studies examine monetary policy, environmental regulation, and trade in isolation. Few analyse how monetary and environmental policies jointly influence trade and investment. This gap is particularly important for open, emerging economies such as Malaysia, where trade competitiveness is sensitive to both financial conditions and sustainability standards.

This study addresses this gap by integrating monetary and environmental policy variables within a unified framework to examine their effects on Malaysia's trade openness. It advances the literature by providing evidence on how macroeconomic and environmental governance interact in shaping external economic performance.

METHODOLOGY

Given the study's aim to explore both short-run and long-run effects of monetary and environmental policies on sustainable trade and investment in Malaysia, the Autoregressive Distributed Lag (ARDL) approach was selected as the most appropriate estimation method. This technique is particularly well-suited for small-sample time-series data, which is often the case in macroeconomic studies covering developing countries.

Unlike other cointegration testing methods such as the Engle-Granger's residual-based (1987) and Johansen's maximum likelihood-based (1988; 1991) and Johansen-Juselius (1990) tests, the ARDL method can be employed despite the stationary properties of the variables. The method also enables simultaneous estimation of both short-term fluctuations and long-term relationships within a single framework, making it ideal for policy-oriented research (Karahan & Bayır, 2022). The model is specified as follows:

$$TO_t = \alpha_0 + \alpha_1 INT_t + \alpha_2 INF_t + \alpha_3 GDPC_t + \alpha_4 EXC_t + \alpha_5 ENV_t + e_t \quad (1)$$

where TO refers to trade openness, INT denotes to interest rate, INF refers to inflation rate in terms of CPI, GDPC denotes to gross domestic product per capital, EXC refers to exchange rate and ENV denotes to environmental policy outcome proxy by CO_2 emission. a_0, a_1, ..., a_5 represent the estimated long-term parameters and e_t denotes the white-noise error term. Constant term, linear trend as well as any dummy variables for structural breaks are all examples of extrinsic factors, are captured using the constant term a_0.

This model is used to assess how monetary policy and environmental performance affect Malaysia's trade integration. Trade openness is a widely used indicator of economic globalization and has been modelled in similar time-series frameworks (Ahmed et al., 2019). CO_2 emissions are included based on growing evidence that sustainability performance increasingly impacts trade, especially with environmentally conscious regions such as the EU (Shaari et al., 2022).

Prior to the ARDL analysis, a preliminary analysis was conducted, which included a standard procedure of unit root test, specifically the Augmented Dickey Fuller (ADF) test. This step was required for this study to ensure absent of *I*(2) variables were involved, as the existence of an *I*(2) variable would render the computed F-statistics in the cointegration testing.

The variables in this study are selected based on their theoretical relevance, previous literature. For monetary policy indicators, the interest rate and inflation are employed to capture Malaysia's monetary stance, as these influence capital flows, investment costs, and overall macroeconomic stability (Karahan & Bayır, 2022). In terms of environmental indicators, while direct policy indices are limited, carbon dioxide (CO_2) emissions per capita is used as outcome-based proxies for environmental governance. This variable reflects the success of policy implementation in areas such as emissions control and the transition to cleaner energy sources (Shaari et al., 2022; Hamzah et al., 2019).

To assess sustainable economic outcomes, trade openness is used to measure Malaysia's degree of integration into global markets. Additionally, GDP per capita and exchange rate included as a control variable to account for differences in economic development and purchasing power, both of which can influence environmental impact and trade performance (Ahmed et al., 2019). The time-series annual data from 1990 to 2020 were targeted for analysis.

FINDINGS

The absence of *I*(2) variables is the pre-requisite for the bound-testing approach in this study As a preliminary checking, ADF unit root test was conducted to examine the order of integration of the variables under the study. The results are reported in Table 1 which confirm that no variable is integrated at *I*(2). This validates the use of the bounds-testing procedure in the subsequent analysis.

Table 1: Results of ADF unit root test

Variable	Level (trend & intercept)	First different (intercept)
INT	-1.81	-5.17***
INF	-1.32	-4.95***
ENV	-1.25	-4.45***
TO	-2.61	-5.91***
EXC	-1.25	-4.45***
GDPC	-0.90	-4.67***

Notes: (***) denotes statistical significance at 1% level; INT refers to the interest rate; INF refers to the inflation rate; ENV represents the CO2 emission; TO represents the trade openness; EXC represents the exchange rate and GDPC represent the GDP per capital.

Table 2 presents the results of the bounds test for the model in this study. As seen in Table 2, the calculated F-statistics exceed the upper bound critical value at the 1% significance level.

These results indicate that there is a statistically significant long-run relationship among the variables. Monetary factors (like interest rate and inflation), economic factors (GDP, exchange rate), and environmental factors (CO_2 emissions) are not drifting apart in the long run. Instead, they establish an equilibrium relationship. The presence of a long-run linkage allows us to proceed to estimating and interpreting the long-run coefficients.

Table 2: Results of bounds test

Level of Significance	Narayan Critical Values		F-statistic
	Lower Limit	Upper Limit	
10%	2.548	3.644	6.540 [0.000]***
5%	3.010	4.216	
1%	4.096	5.512	

Notes: This study assumed unrestricted intercept and no trend (Case III) and referred to the critical values proposed by Narayan (2005).

Referring to the results in Table 3, several factors have meaningful effects on Malaysia's trade openness in the long run. Inflation has a significant negative effect on trade openness. This suggests that higher inflation erodes trade openness, which is likely because when domestic prices rise rapidly, Malaysian exports become less competitive abroad and businesses face uncertainty, thereby reducing trade volumes relative to GDP.

Exchange rate movements also recorded a statistical significance at 1%, which indicate that a depreciation of the Malaysian ringgit is associated with greater trade openness in the long run. The reason is that a weaker ringgit makes Malaysian exports cheaper on the world market, potentially boosting export volumes and, to some extent, discouraging imports. GDP per capita has a positive coefficient and is highly significant, meaning that as Malaysia grows richer, trade openness increases. A growing economy tends to engage in more trade, as people produce and consume more goods and services that cross borders.

The interest rate (OPR) shows a negative coefficient and not statistically significant at conventional levels. Usually, higher interest rates generally signal tighter monetary policy, which could slow economic activity and reduce trade. However, in the long run this effect in Malaysia's data does not appear strong or certain. Finally, the environmental factor, CO_2 emissions, has a negative long-run relationship with trade openness and significant at the 10% level.This finding implies that higher carbon emissions are associated with slightly lower trade openness in the long run. One possible interpretation is that as environmental degradation increases, Malaysia's trade might be constrained by environmental regulations or shifting preferences of trading partners toward greener products. In other words, not addressing pollution could eventually hurt the country's trade opportunities, underscoring the need for sustainable trade practices.

Table 3: Long-run estimation results of ARDL model

Variable	Coefficient
Constant	*1.80**
INT	-0.20
INF	-0.40**
ENV	-0.25*
EXC	0.12**
GDPC	0.15***

Notes: The dependent variable is TO. (***) implies the rejection of the null hypothesis at 1% level of significance; (**) implies the rejection of the null hypothesis at 5% level of significance; (*) implies the rejection of the null hypothesis at 10% level of significance.

Looking at Table 4, the error correction term (ECT) is negative and statistically significant, confirming that any short-term disequilibrium is corrected over time. The short-run dynamics reveal that changes in certain factors have an immediate impact on trade. A change in inflation has a negative short-run effect on trade openness. This means if inflation rises sharply each year, trade openness tends to decrease in that same year, which is consistent with the idea that sudden price increases can quickly make exports less competitive and disrupt trade.

Changes in GDP per capita, which proxy economic growth, have a significant positive short-run effect on trade. Thus, if Malaysia's economy grows faster in a particular year, trade volume also tends to increase immediately, reflecting higher production and consumption leading to more exports and imports. There is also a mild positive short-run impact of exchange rate changes on trade, suggesting that a sudden depreciation of the ringgit can give a quick boost to export volumes within the same year.

On the other hand, interest rate changes do not show a significant immediate effect on trade openness in the short run. This implies that any adjustment in monetary policy (like a rate hike or cut) might not translate into an instantaneous change in trade. The rationale behind this is that businesses may take time to adjust their investment and trade decisions to new interest rate conditions.

Lastly, year-to-year changes in CO_2 emissions do not have a noticeable short-run impact on trade openness. That is, an environmental improvement or deterioration in a single year does not immediately alter trade volumes, which means the influence of environmental factors on trade seems to be more long-term in nature, as discussed in the long-run results.

Table 4: Short-term and error correction representation results of ARDL model

Variable	Coefficient
ΔConstant	*0.02*
$\Delta \mathrm{INT}_{t-1}$	-0.05
$\Delta \mathrm{INF}_{t-1}$	-0.20**
$\Delta \mathrm{GDPC}_{t-1}$	0.10**
$\Delta \mathrm{ENV}_{t-1}$	-0.05
$\Delta \mathrm{EXC}_{t-1}$	0.15*
ECT_{t-1}	-0.50***

Notes: (***) implies the rejection of the null hypothesis at 1% level of significance; (**) implies the rejection of the null hypothesis at 5% level of significance; (*) implies the rejection of the null hypothesis at 10% level of significance.

To ensure the model used in this study are reliable over time, we conducted stability tests using the CUSUM and CUSUM of Squares methods. These tests help us check if the model parameters remained stable throughout the sample period. Figure 1 and Figure 2 show the results of the CUSUM and CUSUM of Squares tests for the overall model. The results of the tests revealed stable estimates of the model.

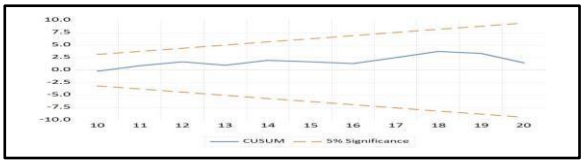

Figure 1: CUSUM Test Plot

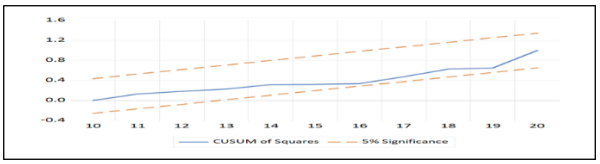

Figure 4.2: CUSUM of Squares Test Plot

These results are important because they validate the accuracy of the ARDL model. A stable model increases the reliability of the findings and suggests that the relationships between monetary and environmental policy variables and trade, are not affected by sudden external shocks or major policy shifts during the sample period (Shaari et al., 2022; Karahan & Bayır, 2022).

CONCLUSION

This study examined how monetary policy and environmental performance jointly influence trade openness in Malaysia. The empirical results confirm the existence of a stable long-run relationship among macroeconomic variables, environmental conditions, and trade, indicating that monetary and environmental policies are structurally interconnected rather than operating independently. Inflation weakens trade competitiveness, while exchange rate depreciation and economic growth support trade expansion. Importantly, higher carbon emissions reduce trade openness in the long run, highlighting that environmental sustainability has become an economically significant determinant of international market access. Short-run dynamics reveal that inflation and economic growth have immediate effects on trade, whereas environmental impacts materialize primarily over time. Interest rate effects, while theoretically relevant, are not statistically strong in Malaysia's long-run trade dynamics.

The findings highlight the need for closer coordination between Bank Negara Malaysia (BNM) and environmental authorities. Although BNM's mandate centres on price and financial stability, monetary policy also influences capital flows between carbon-intensive and green sectors. Integrating climate risk assessments and green finance considerations into financial supervision and macroprudential policy would better align monetary conditions with sustainable trade and investment goals.

The results also support Malaysia's National Energy Transition Roadmap (NETR) by showing that environmental performance affects trade competitiveness. Accelerating decarbonisation in export sectors through green finance, carbon management, and technology upgrading is essential. Sustainability-linked trade incentives, such as green certification and ESG support, can help firms meet stricter global standards.

While this study provides valuable insights into the interplay between monetary and environmental policies in shaping sustainable trade, several avenues remain open for further exploration. Future research could extend this analysis by incorporating more comprehensive environmental indicators, applying sectoral or firm-level data, and employing nonlinear or panel-based models to explore heterogeneous and asymmetric policy effects across industries and economies.

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