CO2 emissions and financial development in an emerging economy: An ARDL approach

Nguyen Thi Thanh Huyen[1]

[1] Department of Research Administration, Academy of Finance,

No. 58 Le Van Hien Road, Duc Thang Ward, Bac Tu Liem District, Hanoi, 100000, Vietnam

DOI: https://doi.org/10.56293/IJMSSSR.2022.4719

IJMSSSR 2023
VOLUME 5
ISSUE 5 SEPTEMBER – OCTOBER **ISSN: 2582 - 0265**

Abstract: This study investigates the impact of economic and financial development, foreign direct investment on carbon emissions within a small emerging economy. The research utilizes the ARDL (AutoRegressive Distributed Lag) methodology to examine the short-term and long-term associations between carbon emissions and a set of economic and financial indicators. The analysis focuses on the period spanning from 2000 to 2020, corresponding to a phase of heightened economic liberalization and financial sector growth. The results showed that there exist both a long run and a short run relationship between variables. Notably, the financial variables demonstrated a discernible influence on carbon emission reduction, albeit primarily during the latter part of the specified period when there was a greater degree of economic liberalization and financial sector expansion. However, it is crucial to highlight that the extent of emission reduction attributed to financial variables remained relatively modest when compared to the emissions amplification effect of rising per capita incomes. This underscores the imperative for the adoption of complementary mitigation strategies aimed at reducing carbon emissions in emerging economies that have not yet achieved a substantial level of financial deepening and financial sector development.

Keywords: CO_2 emission, Economic growth, financial development, Foreign direct investment, Autoregressive Distributed Lag Model.

1. Introduction

Sample text inserted for illustration. Replace with article text, including headings where appropriate. Figures and tables can be single- or double-column width as appropriate. During the production process they will be placed at the top or bottom of columns, after they are first cited in the text.

The extensive body of literature has delved into the intricate connection between economic advancement and environmental deterioration, a concept commonly referred to as the Environmental Kuznets Curve (EKC) hypothesis. In accordance with this hypothesis, an initial positive correlation emerges between economic development and environmental harm when countries endeavor to enhance living standards from their initial low levels, even if such progress entails some degree of environmental detriment. However, as economies progress to more advanced stages of development, the pursuit of improved environmental outcomes becomes progressively crucial. Consequently, the EKC manifests itself as a curve with an inverted U-shape, signifying a peak point where environmental degradation begins to decline with increased economic development. The findings of numerous studies substantiate the presence of this inverted U-shaped relationship between economic development and environmental degradation.

In recent times, climate change and its ramifications for humanity have surfaced as pivotal topics within the global environmental discourse. This has directed heightened scrutiny toward the fundamental drivers of climate change, notably the escalating accumulation of greenhouse gases (GHGs) resulting from human activities.

Examining the relationship between emissions and economic growth in isolation from other facets of economic development might oversimplify a complex process. Economic development is a multifaceted phenomenon that engenders structural shifts within an economy. An integral transformation that coincides with economic growth pertains to the size and configuration of the financial sector, which plays a dual role in supporting both economic expansion and the adoption of eco-friendly, energy-conserving technologies. Literature has extensively documented these structural alterations in the financial sector. As economies progress, their financial sectors tend to occupy larger proportions of the overall economy. This phenomenon extends beyond the banking sector and encompasses the stock market as well. Furthermore, the relative significance of the stock market tends to increase when compared to the banking sector (Demirguc-Kunt et al., 2012). However, it remains unclear how this structural metamorphosis influences the trajectory of CO2 emissions.

A particular perspective posits that CO2 emissions experience an upsurge due to the facilitative role of financial development in mitigating credit constraints. This, in turn, fosters economic growth, leading to amplified energy consumption and a subsequent rise in CO2 emissions. In line with this viewpoint, as described by Sadorsky (2010), efficient financial intermediation encourages consumers to access loans and invest in substantial assets such as automobiles. This heightened consumption and investment behavior are identified as factors contributing to increased CO2 emissions.

In the contemporary literature, there exists a division of viewpoints regarding the influence of financial development on CO2 emissions. Notably, a prevalent approach in these studies involves employing proxies such as FDI (Foreign Direct Investment) and domestic credit to the private sector for gauging the extent of financial development. The collective findings of these investigations yield mixed results. The prevailing trend suggests that a majority of these studies support the notion that private sector credit has a diminishing effect on CO2 emissions, whereas FDI tends to exert an augmenting impact on CO2 emissions. For instance, Ren et al. (2014) conducted a study focused on various industrial sectors within China. Their research revealed that FDI contributed to an increase in emissions within these industrial sectors. This increase was attributed to inefficiencies in resource utilization and technical levels, underscoring the complex interplay between financial development and environmental outcomes.

This paper focuses on clarifying the effects of financial development on CO2 emissions. The study is organized as follows: Section 2 provides an extensive review of the relevant literature. Section 3 outlines the data collection process, introduces the research model, and elucidates the methodology adopted in this research. Section 4 presents the empirical analysis of the data. Finally, Section 5 encapsulates the study with concluding remarks.

2. Literature Review

Not too numerous previous studies examining the influence of financial development on CO2 emissions have been conducted in developing and developed countries all over the world, especially in a particular country such as emerging market economies in Asia, including Vietnam. There exist different empirical results in the previous works consistent with the link between financial development, economic growth and foreign direct investment on CO2 emissions in various situations. The relationship between financial development, economic growth, foreign direct investment and CO2 emissions used to be investigated in some different way with some interesting empirical results.

In their study, Lau et al. (2014) explored the existence of the Environmental Kuznets Curve (EKC) in the context of Malaysia, taking into consideration the influence of Foreign Direct Investment (FDI). Their research findings indicated that in the long-term perspective, FDI was associated with an increase in CO2 emissions.

Recent empirical studies have yielded diverse findings regarding the impact of private sector credit on energy-related emissions, with some suggesting a positive or non-energy reducing effect. For instance, Khan et al. (2014) conducted a study in the context of South Asia, examining the relationship between CO2 emissions and various economic and financial variables, including Foreign Direct Investment (FDI), Money and quasi-money (M2), Liquid liabilities (M3), domestic credit provided by the banking sector, and private sector credit. Their results indicated a positive long-term impact of all these financial variables on CO2 emissions, with no significant short-term effects. These findings lend support to the argument that foreign investment and the provision of liquidity through the banking sector facilitate increased investment in businesses and output expansion, resulting in higher energy consumption and, consequently, greater emissions.

Zhang (2011) made a notable contribution to this discourse by dissecting the scale and efficiency effects of financial development on CO2 emissions in China. Building upon Zhang's work, this study extends the analysis in two ways. Firstly, it investigates how the relationship between CO2 emissions and financial development evolves in the context of a small emerging economy, using Pakistan as a case study. Secondly, while Zhang (2011) relied on the Johansen cointegration approach, assuming that all variables have the same order of integration, our study employs the ARDL (AutoRegressive Distributed Lag) approach, which allows for variables with different orders of integration. Given the potential for economic series to exhibit mixed patterns of integration, our approach offers broader applicability in capturing these complex relationships.

Abbasi, F. & Riaz (2016) found that per capita CO2 emissions were cointegrated with financial development indicators and per capita GDP. The estimated long run model for full sample showed that only GDP per capita had statistically significant impact on CO2 emissions, causing emissions to increase with the standards of living. The more robust estimated long run model for the reduced sample showed that both GDP per capita and percentage of stock turnover in GDP had statistically significant.

Recently, Patel & Mehta (2023) investigated the effects of India's economic growth, industrial development, fossil fuel energy output, financial development and globalisation on CO2 emissions. Using annual time series data from 1971 to 2019, the study used Non-Linear autoregressive distributive lag (NARDL) to examine the relationship. The findings showed a long-term association between CO2 emissions and other factors. While industrialization and economic expansion had a large and long-term positive impact on CO2, globalisation considerably cuts CO2 emissions. The study's findings added to the pool of knowledge by presenting fresh data on the connection between environmental factors and developmental measures.

Islam et al. (2023) looked into ICT's asymmetrical impact on emissions of carbon dioxide (CO2) controlling energy use and financial development (FD) in GCC countries. It uses panel data covering 1995–2019, employs 2nd generation unit root and Westerlund cointegration tests, and applies panel-pooled "generalized least square (GLS)" techniques. The "pooled mean group (PMG)" method and the "Dumitrescu-Hurlin (D-H)" causality test are employed to verify the robustness of GLS estimation. The bootstrap cointegration test corroborates a long-run cointegration among variables. GLS findings exhibit an asymmetric relation between ICT and CO2 emissions; both the affirmative and negative shocks of ICT and FD are associated with decreased CO2 emissions, while energy use enhances the latter. Hence, promoting ICT is essential to reduce CO2 discharges in the GCC region due to its large negative stimulus on CO2 emissions. The PMG estimation also produces findings similar to those of the GLS outcomes and verifies the GLS outcomes' robustness. The D-H causality check also validates the GLS and PMG outcomes.

3. Data and Methodology

3.1. Data

The study attempts to examine the causal nexus of economic growth, financial development, foreign direct investment on CO2 emissions with an evidence from Vietnam by employing a time series data spanning from 2000 to 2020 using the Autoregressive Distributed Lag (ARDL) Model. Two studied variables were employed from the World Bank which will be denoted by GDP, FIN, FDI and CO2.

3.2. Research Model

The mathematical form of the ARDL model used in the article is as follows:

$$D\big(D(CO2)\big)_t = \alpha_0 + \sum_{i=1}^{m} \alpha_i D\big(D(GDP)\big)_{t-i} + \sum_{i=1}^{n} \beta_i D\big(D(FIN)\big)_{t-i} + \sum_{i=1}^{p} \gamma_i D\big(D(FDI)\big)_{t-i} + u_t \quad (3.1)$$

where D is the difference operator; $\alpha_i, \beta_i, \gamma_i$ are the regression coefficients, and u_t is the residual which has a simultaneous correlation but no correlation with its lags and all independent variables. So, the right side of the regression equation consists of the lags of independent and dependent variables.

The ARDL model estimation process can be summarized through the following steps:

Step 1, the stationarity of the variables are verified.
Step 2, the optimal lag for the ARDL model is selected: This is an important step before estimating the ARDL model.
Step 3, the best ARDL model selected in the above step is estimated.
Step 4, the result of ARDL model estimation is back tested:
+ the test in which show that the model is well specified or not: Using Ramsey RESET test;
+ the test of the stability of ARDL model thanks to the cumulative sum of residuals (CUSUM: Cumulative Sum of Recursive Residuals).
+ the test the residual of ARDL model without autocorrelation thanks to Lagrange Multiplier test (abbreviated as LM test).
If the estimated ARDL model is appropriate, then the ARDL model can be used to describe the impact of tariff on economic in the short term.
Step 5, to see whether there exists a co-integration between variables or not, we implement the Bound Test.
Details of the ARDL model can be found in Chapter 17 of Gujarati (2004).

4. Results of Economic Modeling

4.1. Descriptive Statistics

Table 1: Descriptive Statistics

	CO2	GDP	FIN	FDI
Mean	157.9589	6.432126	78.47164	7.767095
Median	151.4135	6.690009	80.00103	8.000000
Maximum	355.3231	7.547248	115.5253	16.12000
Minimum	51.20770	2.865412	35.25907	1.298000
Std. Dev.	88.65652	1.054457	23.93780	5.228596
Skewness	0.874816	-1.871603	-0.328213	0.132426
Kurtosis	2.898447	7.225043	2.030001	1.769453
Jarque-Bera	2.687583	27.87976	1.200321	1.386344
Probability	0.260855	0.000001	0.548724	0.499988
Sum	3317.136	135.0746	1647.904	163.1090
Sum Sq. Dev.	157199.6	22.23759	11460.37	546.7643
Observations	21	21	21	21

Source: Result from the analysis

Table 1 presents data description including 21 observations of each variable of Vietnam over a 21-year period from 2000 to 2020.

4.2. Correlation analysis

Table 2: Correlation Coefficents between Variables

	CO2	GDP	FIN	FDI
CO2	1.000000 ---			
GDP	-0.288187 0.2052	1.000000 ---		

FIN	0.859514 0.0000	-0.273562 0.2302	1.000000 ---	
FDI	0.940956 0.0000	-0.262543 0.2502	0.919829 0.0000	1.000000 ---

Source: Result from the analyis

It is evident that there may be a positive correlation existence between financial development and CO2 emission since the correlation coefficient is 0.859514 with a very ideal probability value nearly be zero. In addition, there may be also a positive correlation existence between foreign direct investment and CO2 emission since the correlation coefficient is 0.940956 with a very ideal probability value nearly be zero We exceed to further study the relationship in detail.

Another test we used in the study is that the analysis needs to check the station of time series. We transform time series which are non-stationary to station ones. It means that after being transformed, times series have expectation, variance and covariance is constant over time. The time series in ARDL model must be stationary. Station character is an important concept when studying time series. However, in fact, most financial data series are non-stationary. To test the station, we use unit root tests, thanks to a common test Augmented Dicky-Fuller test (ADF test). We use the unit root test with the order of lag is automatically selected according to Schwarz criterion, with intercept for variables. ADF tests for the initial time series, and their first difference will be performed. Usually, after taking the first difference, we get the stationary time series for FIN, FDI, but second difference for GDP, CO2. The use of the second difference of time series is not only to obtain stationary time series, but also the second difference series could provide information about increasing or decreasing trend (depending on the sign of the difference) rather than focusing on providing information about the real value of the time series.

Table 3: ADF Stationarity test results of the time series at 6% significance

Variable	Augmented Dicky-Fuller test		Conclusion
	Statistical value	Corresponding probability	
CO2	2.651035	0.9999	Non-stationary
D(CO2)	-2.679668	0.0957	Non-stationary
D(D(CO2))	-5.758986	0.0003	Stationary
GDP	-2.035902	0.2704	Non-stationary
D(GDP)	-2.485740	0.1349	Non-stationary
D(D(GDP))	-2.965117	0.0587	Stationary
FIN	-1.101937	0.6939	Non-stationary
D(FIN)	-4.403316	0.0030	Stationary
D(D(FIN))	-8.295664	0.0000	Stationary
FDI	-0.174690	0.9273	Non-stationary
D(FDI)	-3.682242	0.0136	Stationary
D(D(FDI))	-5.549493	0.0003	Stationary

Source: Result from the analysis

The results in Table 3 shows that all variables are non-station at level, but first different level series of FIN and FDI as well as second different level series of GDP and CO2 are station at a significance level of 6%. So that, we can put all second different level series in to ARDL model for investigation.

4.3. Discussion of Estimation Models

First of all, Hannan-Quin information criterion value is used to choose the most appropriate model. The traditional way to select the optimal lag is to estimate the ARDL model multiple times with descending lags to 0. Among the estimated ARDL models, we choose the one with smallest Hannan-Quin information criterion value. In this article, the authors try out up to the top two lags for dependent variable and top three lags for regressors and selects the recommended model according to Hannan-Quin criterion. The image depicting Hannan-Quin's criterion value for the best twenty models, including the best model. Thanks to this Hannan-Quin information criterion, the best ARDL selected is that ARDL(1,3,3,3).

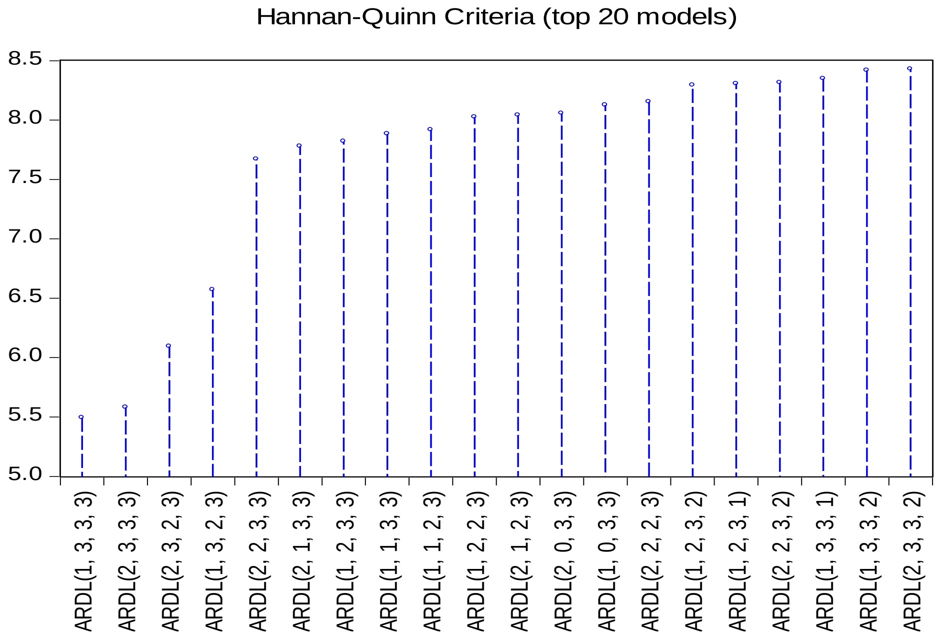

Figure 1: Hann-Quin's Criteria for the twenty Best Models
Source: Result from the analysis

4.4. Results of Econometric Modeling

ARDL(1,3,3,3) is estimated as in the following Table 4.

Table 4: Results of ARDL(1,3,3,3) model estimation with dependence variable of CO2

Variable	Coefficient	Std. Error	t-Statistic	Probability
D(D(CO2(-1)))	0.372639	0.131261	2.838913	0.1049
D(D(GDP))	4.365422	1.314641	3.320620	0.0800
D(D(GDP(-1)))	52.59566	10.05231	5.232199	0.0346
D(D(GDP(-2)))	-12.88239	3.041861	-4.235037	0.0515
D(D(GDP(-3)))	32.75780	7.107852	4.608678	0.0440
D(D(FIN))	0.767841	0.219913	3.491565	0.0731
D(D(FIN(-1)))	-3.423990	0.599241	-5.713877	0.0293
D(D(FIN(-2)))	-1.964486	0.306286	-6.413894	0.0235
D(D(FIN(-3)))	0.417892	0.193423	2.160510	0.1633
D(D(FDI))	0.827137	1.053282	0.785295	0.5145
D(D(FDI(-1)))	16.01955	1.880096	8.520602	0.0135
D(D(FDI(-2)))	18.29874	3.823446	4.785927	0.0410
D(D(FDI(-3)))	12.70770	2.001774	6.348218	0.0239
C	-2.943882	1.558514	-1.888903	0.1995

Source: Result from the analysis

a. Autocorrelation test

Based on the Breusch-Godfrey Serial Correlation LM Test, we have:

The Null hypothesis H0: no first order autocorrelation

The Alternative hypothesis Ha: existence of an autocorrelation

At this stage, autocorrelation test used for null hypothesis: "no first order autocorrelation", the Breusch-Godfrey Serial Correlation LM Test is used. According to the results in Table 5, the p-value of the ARDL (1,3,3,3) model is far from zero. They are all larger than 0.05 so that null hypothesis is not rejected, which indicated that there is no autocorrelation between variables in the model.

Table 5: LM test for the residual of the ARDL model

F-statistic	3.886647	Prob. F(1,1)	0.2988

Source: Result from the analysis

b. Model specification Test

To test for model specification of ARDL (1,3,3,3), the Ramsey Reset test is performed. In the theory, if the test result with p-value over 0.05, so the model is well specified at the significant level at 5 percent. In a result, Table 6 indicates that the test results with p-values are all over 0.05, which proved that the model is well specified.

Table 6: Model specification Test

	Value	Degree of freedom	Probability
t-statistic	5.616508	1	0.1122
F-statistic	31.54516	(1, 1)	0.1122

Source: Result from the analysis

c. Stability test

The next back testing is that the stability of ARDL model thanks to the cumulative sum of residuals and square of residuals. If the cumulative sum of the residuals and square of residuals are both within the standard range at the 5% significance level, then it can be concluded that the residual of the model is stable and thus the model is stable.

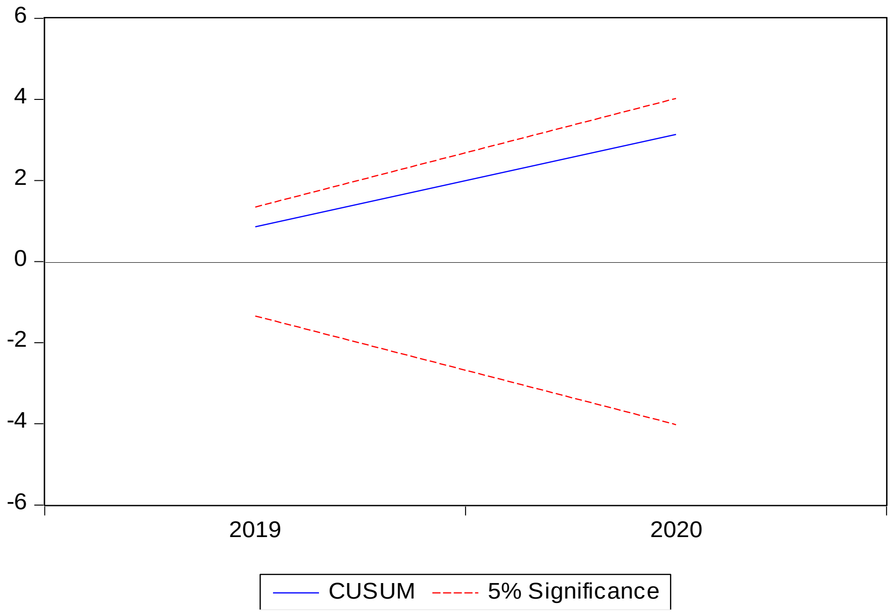

Figure 2: The cumulative sum of residuals of the ARDL model at a 5% significance level
Source: Result from the analysis

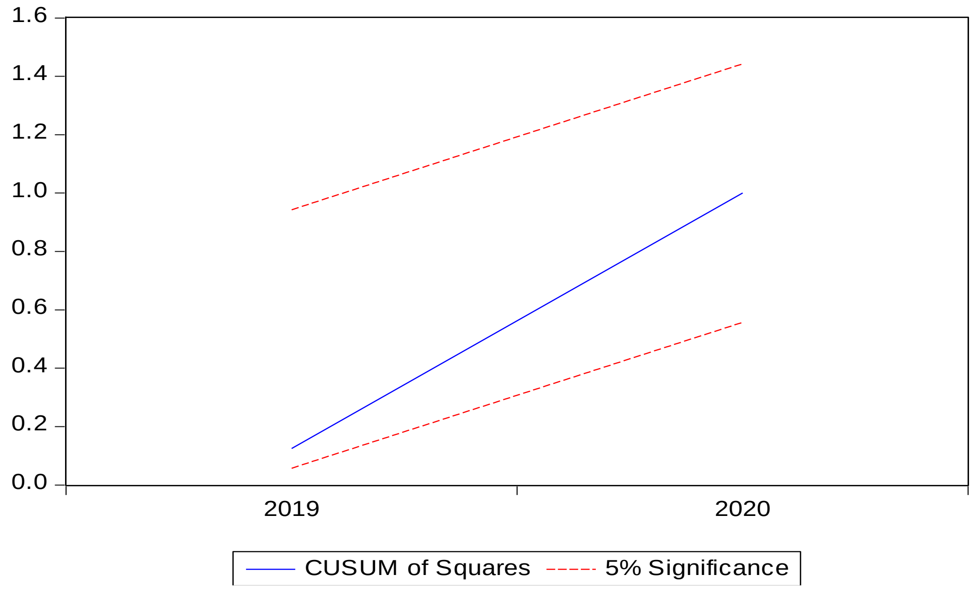

Figure 3: The cumulative sum of square of residuals of the ARDL model at a 5% significance level
Source: Result from the analysis

To go further to investigate the long-run relationship among the above considered variables, we use cointegration test thanks to Bound test.

Table 7: Test of long-run relationship between the variables

Null Hypothesis: No long-run relationships exist		
Test Statistic	Value	k
F-statistic	26.84650	3
Critical Value Bounds		
Significance	I0 Bound	I1 Bound
10%	2.72	3.77
5%	3.23	4.35
2.5%	3.69	4.89
1%	4.29	5.61

Source: Result from the analysis

According to Table 7, the test statistic value is larger than every critical Value Bounds at every significance levels. Therefore, there exists a long run relationship between tariff and economic growth. That long-run from is presented in Table 8.

Table 8: Long-run relationship between the variables

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GDP, 3)	4.365422	1.314641	3.320620	0.0800
D(GDP(-1), 3)	12.882395	3.041861	4.235037	0.0515
D(GDP(-2), 3)	-32.757797	7.107852	-4.608678	0.0440
D(FIN, 3)	0.767841	0.219913	3.491565	0.0731
D(FIN(-1), 3)	1.964486	0.306286	6.413894	0.0235
D(FIN(-2), 3)	-0.417892	0.193423	-2.160510	0.1633
D(FDI, 3)	0.827137	1.053282	0.785295	0.5145
D(FDI(-1), 3)	-18.298735	3.823446	-4.785927	0.0410
D(FDI(-2), 3)	-12.707695	2.001774	-6.348218	0.0239

CointEq(-1)	-0.627361	0.131261	-4.779490	0.0411
Cointeq = D(D(CO2)) - (122.4757*D(D(GDP)) -6.6991*D(D(FIN)) + 76.2768*D(D(FDI)) -4.6925)				
Long Run Coefficients				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(D(GDP))	122.475677	40.499444	3.024132	0.0942
D(D(FIN))	-6.699078	2.310156	-2.899838	0.1012
D(D(FDI))	76.276819	23.942403	3.185846	0.0860
C	-4.692484	3.101934	-1.512761	0.2695

Source: Result from the analysis

In the co-integration test, the co-integration regression coefficient is negative (- 0.627361) and is statistically significant at 5% (with a small probability value of 0.0411) indicating that co-integration relationship exists between variables. That is, in the long term when the system is in equilibrium, when a shock occurs, the variables in the model tend to move, "pull" the whole system "back" to the equilibrium, which means a reverse movement tendency (the negative sign of the co-integration regression coefficients) compared to those fluctuations. The co-integration equation, or equation that represents the long-run equilibrium relationship among the variables is as follows:

D (D (CO2)) = 122.4757*D(D(GDP)) -6.6991*D(D(FIN)) + 76.2768*D(D(FDI)) - 4.6925 + ut (4.1)

5. Conclusion

According to Figure 1, the estimation of the ARDL (1,3,3,3) is finally selected as the best model to discuss. Regarding the estimation results, our analysis shows the impact of economic growth, financial development and foreign direct investment on CO2 emissions – in the case of Vietnam, we have the result in short run in the following Table 9:

Table 9: Short-run impacts of the variables on CO2 emissions at second differential

Variables	Regression coefficients	Probability value
D(D(CO2(-1)))	0.372639	0.1049
D(D(GDP))	4.365422*	0.0800
D(D(GDP(-1)))	52.59566**	0.0346
D(D(GDP(-2)))	-12.88239*	0.0515
D(D(GDP(-3)))	32.75780**	0.0440
D(D(FIN))	0.767841*	0.0731
D(D(FIN(-1)))	-3.423990**	0.0293
D(D(FIN(-2)))	-1.964486**	0.0235
D(D(FIN(-3)))	0.417892	0.1633
D(D(FDI))	0.827137	0.5145
D(D(FDI(-1)))	16.01955**	0.0135
D(D(FDI(-2)))	18.29874**	0.0410
D(D(FDI(-3)))	12.70770**	0.0239
C	-2.943882	0.1995

*Note: *, ** indicateS significance level of 10%, 5%*
Source: Result from the analysis

Thanks to results in Table 9, we can see that economic growth in this year and the previous first, second and third years cause, respectively, a pull, a pull, a reduction then a pull in CO2 emissions this year. This result is different among different countries. At the same time, it is important to find that financial development this year makes positive impact on CO2 emissions while the financial development in two previous years have negative impact on financial development. Meanwhile, foreign direct investment in and the previous first, second and third years all have positive impact on CO2 emissions.

Regarding the long-run equilibrium relationship among the variables is as in equation (4.1), in which, economic growth and financial development in Vietnam have caused increasing in CO2 emissions. This underscores the imperative for the adoption of complementary mitigation strategies aimed at reducing carbon emissions in emerging economies that have not yet achieved a substantial level of financial deepening and financial sector development.

In conclusion, this study investigates the impact of economic and financial development, foreign direct investment on carbon emissions within a small emerging economy. The research utilizes the ARDL (AutoRegressive Distributed Lag) methodology to examine the short-term and long-term associations between carbon emissions and a set of economic and financial indicators. The analysis focuses on the period spanning from 2000 to 2020, corresponding to a phase of heightened economic liberalization and financial sector growth. The results showed that there exist both a long run and a short run relationship between variables. Notably, the financial variables demonstrated a discernible influence on carbon emission reduction, albeit primarily during the latter part of the specified period when there was a greater degree of economic liberalization and financial sector expansion. However, it is crucial to highlight that the extent of emission reduction attributed to financial variables remained relatively modest when compared to the emissions amplification effect of rising per capita incomes. These findings are crucial for policymakers and governmental agencies to focus on economic development without endangering environmental damage. Vietnam has to enact laws that support cleaner production practises and the growth of non-polluting sectors in order to uphold its commitment to sustainability. It must also discourage CO2 emitting industries concurrently.

References

1. Abbasi, F. & Riaz, K. 2016. CO2 emissions and financial development in an emerging economy: An augmented VAR approach, Energy Policy, Volume 90, Pages 102-114, https://doi.org/10.1016/j.enpol.2015.12.017.
2. Demirguc-Kunt, A., Feyen, E., Levine, R., 2012. The Evolving Importance of Banks and Securities Markets. Unpublished results.
3. Gujarati, D. 2004. Basic Econometrics. 4th Edition, McGraw-Hill Companies, New York.
4. Islam, M. S.; Rahaman, S. H.; Rehman, A. & Khan, I. 2023. ICT's impact on CO2 emissions in GCC region: The relevance of energy use and financial development, Energy Strategy Reviews, Volume 49, 101147, https://doi.org/10.1016/j.esr.2023.101147.
5. Khan, M.A., Khan, M.Z., Zaman, K., Irfan, D., Khatab, H., 2014. Questing the three key growth determinants: Energy consumption, foreign direct investment and financial development in South Asia. Renew. Energy 68, 203–215.
6. Lau, L.S., Choong, C.K., Eng, Y.K., 2014. Investigation of the environmental Kuznets curve for carbon emissions in Malaysia: do foreign direct investment and trade matter? Energy Policy 68, 490–497.
7. Patel, N. & Mehta, D. 2023. The asymmetry effect of industrialization, financial development and globalization on CO2 emissions in India, International Journal of Thermo fluids, Volume 20, 100397, https://doi.org/10.1016/j.ijft.2023.100397.
8. Ren, S., Yuan, B., Ma, X., Chen, X., 2014. International trade, FDI (foreign direct investment) and embodied CO2 emissions: a case study of Chinas industrial sectors. China Econ. Rev. 28, 123–124.
9. Sadorsky, P., 2010. The impact of financial development on energy consumption in emerging economies. Energy Policy 38, 2528–2535.
10. Zhang, Y.J., 2011. The impact of financial development on carbon emissions: an empirical analysis in China. Energy Policy 39, 2197–2203.