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Does Institutional Quality Modify the Shadow Economy – Environmental Pollution Nexus? Evidence from an Emerging Market

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ABSTRACT

This study aims to examine the impact of the shadow economy on environmental pollution and the moderating role of institutional quality in the relationship between shadow economy and environmental pollution in Vietnam in the period 1996-2017. The study uses the autoregressive distributed lag (ARDL) method of Pesaran et al. (2001). The results indicate that institutional quality, economic growth and inflation positively contribute to the increase in environmental pollution. Meanwhile, trade openness reduces the level of environmental pollution in Vietnam during the study period. Interestingly, the interaction variable between shadow economy and institutional quality has a significant and negative effect on environmental pollution in Vietnam. Our results coincide in both the short and long term. The study provides empirical evidence for policymaker to consider when choosing optimal policies to manage shadow economy and policies related to limiting environmental pollution for sustainable economic development in Vietnam.

INTRODUCTION

In the context of economic globalization, developing countries are facing problems related to shadow economy and environmental pollution (Dada and Ajide, 2021, Tran, 2021). Carbon dioxide (CO2) emissions is widely considered as the predominant cause for climate change in developing countries (Wawrzyniak and Doryn, 2020). Besides, the shadow economy accounted for about 36% of the total GDP of developing countries in 2002-2015 period (Medina and Schneider, 2018). As a result, different policy institutions have been introduced to control emissions as well as the size of shadow economies. Dada et al. (2021) argue that the existence of the shadow economy is due to the institutional environment. Compared with developed countries, the quality of institutions in developing countries still has many shortcomings and limitations, which is one of the reasons why the shadow economy in developing countries always exists (Dada and Ajide, 2021; Makarenko et al., 2021). In addition, the increase in the size of the shadow economy will distort the allocation of resources, change the distribution of income and reduce tax revenue for the government (Alm and Embaye, 2013). Besides, CO2 emissions in Vietnam hit 305.2 million metric tons in 2019 (Nguyen, 2021). Especially, CO2 emissions had been rising year on year in

Vietnam in 2017-2019 period. This poses challenges for Vietnam in the quality of institutions towards sustainable development, balancing between economic development and environmental protection.

In addition, the importance of institutional quality in the relationship between carbon dioxide emissions and economic growth is of increasing interest (Wawrzyniak and Doryn, 2020; Haseeb et al., 2021). Besides, the role of institutional quality in the relationship between shadow economy and air pollution also needs to be examined more closely (Dada et al., 2021). Meanwhile, recent studies are increasingly interested in institutional quality and shadow economy in Vietnam (Huynh, 2020; Huynh and Ho, 2020; Krivokapic, 2020; Simovic, 2020). However, the moderating role of institutional quality in the relationship between shadow economy and environmental pollution has been largely ignored in previous studies in Vietnam. To fill this gap, this study examines the moderating role of institutional quality in shadow economy and environmental pollution nexus.

From the above practical and academic reasons, this study is carried out. The contribution of this study is expressed in three points as follows. First, this is the first study to examine the moderating role of institutional quality on the relationship between the shadow economy and CO2 emissions. This study uses the autoregressive distributed lag (ARDL) method to estimate the regression model for Vietnam in the period 2000–2017. Second, the study provides empirical evidence on how institutional quality and shadow economy interact to alter CO2 emissions. Third, the study provides empirical evidence that helps emerging countries governments strengthen their decisions in formulating institutional reform policies to control CO2 emissions and the size of shadow economy.
Following this introduction, the remainder of this study is organized as follows. Literature review are presented in Section 2. Section 3 discusses the data and research methodology. Empirical findings and discussions are shown in Section 4, while the conclusions and policy implications in Section 5.

1. LITERATURE REVIEW

Previous studies (Luong et al., 2020; Ihrig and Moe, 2004; Hart, 2008) define the shadow economy or the informal economy as a set of economic activities that take place outside the mainstream economic context. Dada and Ajide (2021) argue that although income in this sector is derived from the production of legitimate goods and services, it is still considered an illegal economy because most activities are not recorded. In addition, Ajide (2021) also clearly states that transactions that are not presented to the tax authorities should be considered illegal. Medina and Schneider (2018) emphasize that the informal economy is difficult to measure. Meanwhile, Hashimzade and Heady (2016) show that different shadow economy measures produce different results. Previous studies (Ajide et al., 2021; Schneider and Buehn, 2018; Mishchuk et al., 2020) indicate that it is possible to approach the shadow economy in two ways: direct and direct pricing. The indirect approach involves the use of macroeconomic variables while the direct approach uses the survey method to gather relevant information at the micro level. According to (Schneider and Enste, 2000) the main advantage of the indirect approach is that it overcomes the problem encountered by the survey method. Some indirect approaches include the currency demand approach, multiple indicators multiple cause (MIMIC) estimation, the structural equation method, and others (Bui, 2020; Schneider and Buehn, 2018; Petersen et al., 2010; Dell'Anno et al., 2007; Navickas et al., 2020).

Gholipour and Farzanegan (2018) reveal that the effectiveness of government environmental protection spending facilitates a reduction in both PM10 and CO2 emissions when utilized data of Middle East and North Africa countries in 1996 - 2015 period. In addition, Abid (2016) examines the effect of the institutional framework on CO2 emissions in Sub-Saharan Africa countries between 1996 and 2010. Author states that government effectiveness, political stability, democracy, and control of corruption contribute to a reduction in pollution. In additon, rule of law and regulatory quality lead to environmental degradation. Apergis and Ozturk (2015) use government effectiveness, political stability and absence of violence, quality of regulations and corruption control as four institutional quality indicators. They reveal that all four institutional quality indicators impact on CO2 emissions in Asia countries. Besides, Ozturk and Al-Mulali (2015) found an inverted U-shaped relationship between CO2 emissions and per capita income in Cambodia. They emphasize that combining variables reflecting corruption control and govern-

ment effectiveness does not lead to a confirmatory relationship. Gani (2012) also examines the impact of five institutional quality indicators, including rule of law, political stability, control of corruption, regulatory quality and government effectiveness, on CO2 emissions per capita in 99 developing economies. He states that rule of law, political stability and control of corruption are inversely and statistically significantly associated with CO2 emissions per capita while the effect of regulatory quality and government effectiveness are not confirmed.

2. DATA AND RESEARCH METHODOLOGY

2.1 Data

Annual data in the period 1996-2017 for Vietnam are utilized in this paper. Data is extracted from three main sources, including shadow economy data proposed by Medina and Schneider (2019), Worldwide Governance Indicators (World Bank, 2021a) and World Development Indicators (WDI) (World Bank, 2021b).

2.2 Measurement of variables

In this study, environmental pollution is measured by CO2 emissions (metric tons per capita); shadow economy is calculated as per cent of GDP; Institutional quality is proxied by government effectiveness estimate. In addition, this study also utilized four control variables, including economic growth (natural logarithm of GDP per capita, constant 2010 US$); trade openness (per cent of GDP); urban population (per cent of total population) and inflation, consumer prices (annual %). Table 1 illustrates a summary of measurements of the variables and relevant data sources utilized in this paper.

Table 1. Measurements of variables and data sources

Variables	*Abbreviation*	*Measurement*	*Data source*
		Dependent variable	
Environmental pollution	CO2	CO2 emissions (metric tons per capita)	WDI
		Independent variables	
Shadow economy	SE	Shadow economy (per cent of GDP)	Medina and Schneider (2019)
Institutional quality	GE	Government Effectiveness	WGI
Control variables			
Economic growth	LGDPP	Natural logarithm of GDP per capita (constant 2010 US$)	WDI
Trade openness	TR	Trade (per cent of GDP)	WDI
Urban population	UBP	Urban population (% of total population)	
Inflation	INF	Inflation, consumer prices (annual %)	WDI

In addition, the following models are used to explore the long-term relationship between shadow economy, institutional quality and environmental pollution.

$$CO2_t = \beta_0 + \beta_1 SE_t + \beta_2 GE_t + \beta_3 LGDPP_t + \beta_4 TR_{it} + \beta_5 UBP_t + \beta_6 INF_t + \beta_7 SE*GE_t + \varepsilon_t$$

where: SE*GE is the interaction variable between shadow economy and institutional quality.

Table 2 shows that environmental pollution (represented by CO2 emissions) of Vietnam vary from 0.449 metric tons per capita to 2.390 metric tons per capita. These figures confirm a large disparity in this country in CO2 emissions during the 1996-2017 period. Besides, the difference in shadow economy

is also significant, ranging from 12.5 per cent of GDP to 20.6 per cent of GDP. The average institutional quality in Vietnam in the period is -0.282.

Table 2. Descriptive statistics of the full sample

Variables	*Observations*	*Mean*	*Min.*	*Max.*	*Std. Dev.*
CO2	22	1.272	0.449	2.390	0.613
SE	22	0.171	0.125	0.206	0.024
GE	22	-0.282	-0.745	-0.426	0.173
LGDPP	22	6.989	6.442	7.524	0.336
TR	22	1.394	0.927	2.003	0.309
UBP	22	0.284	0.225	0.352	0.039
INF	22	0.064	-0.017	0.231	0.056
SE*GE	22	-0.052	-0.119	0.009	0.034

Notes: CO2: Environmental pollution; SE: Shadow economy; GE: Institutional quality; LGDPP: economy growth; TR: trade openness; UBP: urban population; INF: Inflation; SE*GE: interaction variable between shadow economy and institutional quality.

3. RESULTS

3.1 Stationarity tests

Most of economic variables tend to change over time, so to avoid spurious regression results, the author first tests the stationarity of all variables. This study utilizes Augmented-Dickey-Fuller test (Dickey and Fuller, 1981) and Phillip-Perron (Phillip and Perron, 1988) test to explore unit root tests. As shown in Table 3, all variables are stationary at first difference. Specifically, INF stationary at level and the remaining variables stationary at first difference. This satisfies the conditions for applying the ARDL method (Pesaran et al., 2001).

Table 3. Unit root test results

Variables	*Augmented-Dickey-Fuller*		*Phillip-Perron*		*Structural breaks*	
	In levels	*In first different*	*In levels*	*In first different*	*In levels*	*In first different*
CO2	0.574	-3.171**	0.614	-3.099**	-4.721*	-5.700***
SE	1.301	-4.794***	1.996	-4.835***	-3.325	-5.458***
GE	-1.228	-4.824***	-1.240	-4.902***	4.115	-4.730*
LGDPP	-0.660	-3.207**	-0.575	-3.313**	-4.162	-5.087**
TR	0.118	-5.087***	0.843	-5.676***	-6.439***	-8.101***
UBP	1.090	-3.577***	6.525	-3.013**	-2.327	-13.075***
INF	-2.886**	-6.397***	-2.834*	-7.353***	-4.309	-6.848***
SE*GE	-0.413	-4.150***	-1.462	-5.514***	-3.872	-5.585***

Notes: *, **, *** signify significance at 10%, 5% and 1% levels, respectively.

CO2: Environmental pollution; SE: Shadow economy; GE: Institutional quality; LGDPP: economy growth; TR: trade openness; UBP: urban population; INF: Inflation; SE*GE: interaction variable between shadow economy and institutional quality.

In addition, this study uses bound test, proposed by Pesaran et al. (2001) to explore cointegration. With the null hypothesis is no cointegration between the variables. According to the results in Table 4, the statistic F = 7.926 > Critical value = 4.26 at 1% significance level. Hence, the hypothesis H0 is re-

jected, proving that there is a cointegration relationship in the long run between the variables in the model.

Table 4. ARDL Bounds test results

Test statistic	*Value*	*Sig.*	*Lower Bound I(0)*	*Upper Bound I(1)*
F-statistic	7.926	1%	2.96	4.26
k	7	2.5%	2.60	3.84
		5%	2.32	3.50
		10%	2.03	3.13

This study examines the short-term effects of institutional quality and shadow economy on environmental pollution. The results are shown in Table 5. In the short term, institutional quality has a positive and significant impact on environmental pollution. Besides, economic growth and inflation also contribute to increasing environmental pollution in Vietnam. Meanwhile, trade openness has a negative effect on CO2 emissions. In addition, when there is an interaction between the shadow economy and institutional quality, it will reduce the level of environmental pollution in Vietnam in the short term.

Table 5. Short-run estimation results (*CO2* as dependent variable)

Variables	*Coefficient*	*t-statistics*	*Prob.*
△SE	-14.942	-1.36	0.211
△GE	4.587**	2.40	0.043
△LGDPP	5.256**	2.50	0.037
△TR	-1.264***	-3.47	0.008
△UBP	46.583	0.76	0.468
△INF	1.216**	3.27	0.011
△SE*GE	-26.741*	-2.20	0.059
Constant	-27.041**	-3.31	0.011
ECM (-1)	-1.418***	-5.31	0.001

Notes: *, **, *** signify significance at 10%, 5% and 1% levels, respectively.

CO2: Environmental pollution; SE: Shadow economy; GE: Institutional quality; LGDPP: economy growth; TR: trade openness; UBP: urban population; INF: Inflation; SE*GE: interaction variable between shadow economy and institutional quality

In addition, the author estimates the long-run impact of shadow economy and institutional quality on Vietnam's environmental pollution. The results are illustrated in Table 6. The results indicate that institutional quality, economic growth and inflation have a positive influence on CO2 emissions in Vietnam in long-run. Meanwhile, trade openness reduces CO2 emissions in the country. In particular, the results also reveal that the interaction variable between the shadow economy and institutional quality reduces CO2 emissions in Vietnam with a significance level of 1%.

Table 6. Long-run estimation results (*CO2* as dependent variable)

Variables	*Coefficient*	*t-statistics*	*Prob.*
SE	-10.5532	-1.57	0.154
GE	7.676***	6.50	0.000
LGDPP	3.705**	2.91	0.020
TR	-1.653***	-5.12	0.001
UBP	-6.499	-0.62	0.552
INF	0.857***	3.91	0.004
SE*GE	-42.205***	-5.45	0.001
R-Squared	0.928		
Adj R -Squared	0.822		
Durbin Watson	2.224		

Notes*:* *, **, *** signify significance at 10%, 5% and 1% levels, respectively.

CO2: Environmental pollution; SE: Shadow economy; GE: Institutional quality; LGDPP: economy growth; TR: trade openness; UBP: urban population; INF: Inflation; SE*GE: interaction variable between shadow economy and institutional quality.

Next, this article performs additional tests of some defects that the model may encounter, including: LM test for autoregressive conditional heteroskedasticity (ARCH), Breusch-Godfrey LM test for autocorrelation, White's test for homoskedasticity, Breusch-Pagan/Cook-Weisberg test for heteroskedasticity and Ramsey reset test. According to the test results in Table 7, all tests have Prob > 0.05, so they reject the hypothesis H0, that is, the regression model does not encounter the phenomenon of autocorrelation, heteroskedasticity, missing variables and the residuals are normal distribution. Hence, it can be concluded that the obtained regression results are reliable.

Table 7. Model diagnostics

Test	*Value*
LM test for autoregressive conditional heteroskedasticity (ARCH)	0.742
Breusch-Godfrey LM test for autocorrelation	0.171
White's test for homoskedasticity	0.397
Breusch-Pagan / Cook-Weisberg test for heteroskedasticity	0.698
Ramsey reset test	0.371

Next, the study tests the stability of the regression model by testing the cumulative sum of recursive residuals (CUSUM) and the cumulative sum of squares recursive residuals (CUSUM of Squares). Figure 1 and 2 show that both the CUSUM and CUSUM of Squares lines (solid lines) of the regression model are within the standard range at 5% significance level (dashed lines). In other words, the estimated results are reliable.

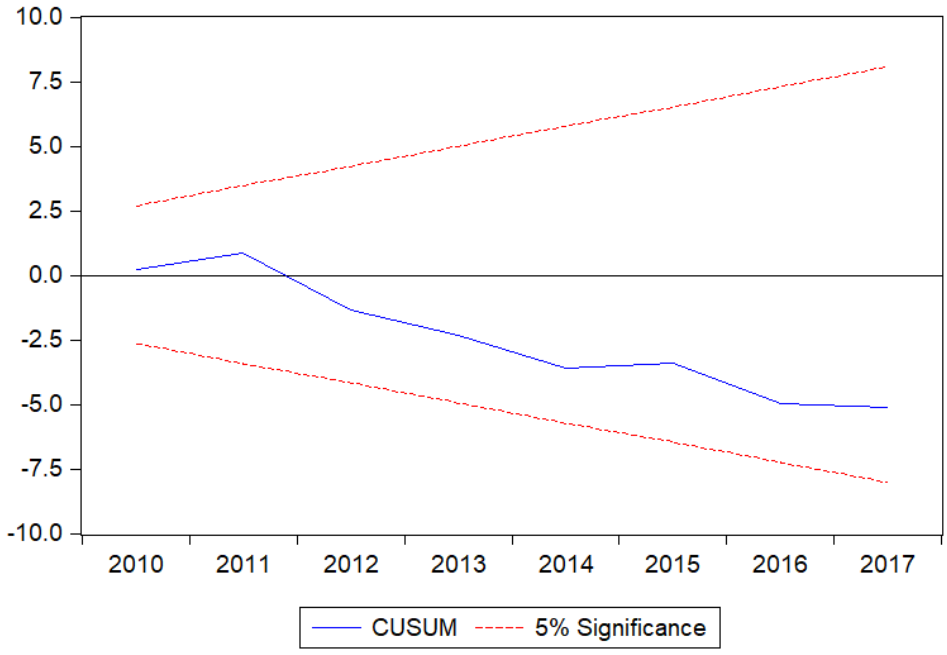

Figure 1. Plot of cumulative sum of recursive residuals

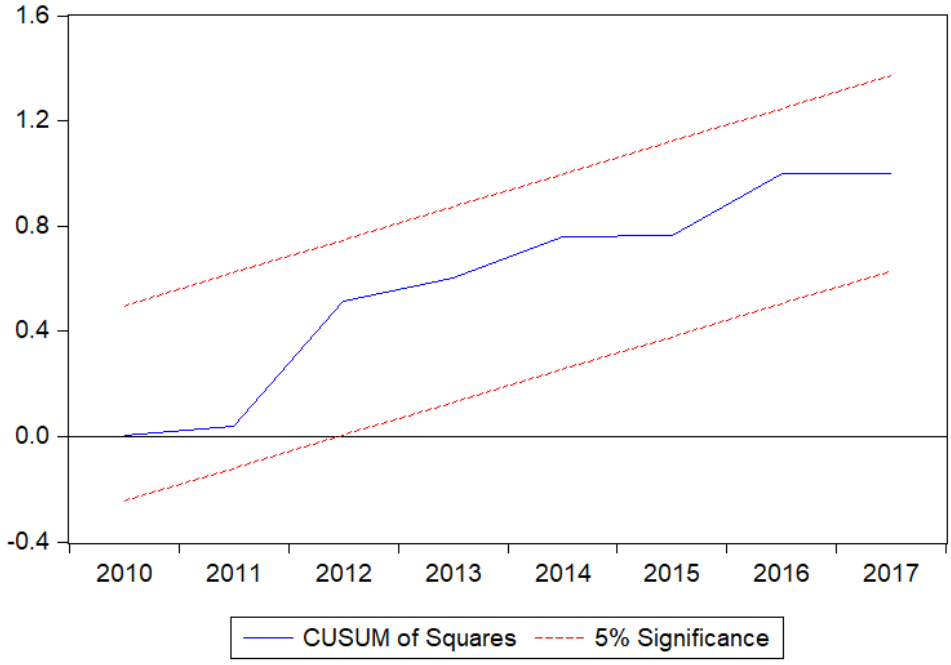

Figure 2. Plot of cumulative sum of squares recursive residuals

CONCLUSION

Countries all over the world face problems of underground economy and environmental pollution. The effects of shadow economy and environmental pollution on economic growth have been considered in previous studies (Egbetokun et al., 2020; Huynh and Ho, 2020). However, most previous studies have neglected to consider the influence of the shadow economy on environmental pollution and the regulatory role of institutional quality in this relationship, especially in emerging market like Vietnam. This study examines the moderating role of institutional quality in the relationship between the underground econ-

omy and environmental pollution in Vietnam in the period 1996-2017. The ARDL method, proposed by Pesaran et al. (2001) is used. The results indicate that institutional quality, economic growth and inflation positively contribute to the increase in environmental pollution. Meanwhile, trade openness reduces the level of environmental pollution in Vietnam during the study period. Interestingly, the interaction variable between shadow economy and institutional quality has a significant and negative effect on environmental pollution in Vietnam. These results coincide in both the short and long term.

From the experimental results, the author suggests some policy implications as follows. Firstly, economic growth contributes to an increase in CO2 emissions. Hence, policy makers need to ensure a balance between economic growth and sustainable development in the future. Policies to control emissions or tax carbon need to be considered. Second, the results of this study indicate that the interaction between institutional quality contributes to limiting environmental pollution. In addition, institutional quality can affect the rigor of environmental regulations and enforcement as well as the size of the shadow economy (Wawrzyniak and Doryn, 2020). Therefore, policy makers in emerging markets also need to take appropriate actions to both ensure the goal of controlling the shadow economy, while also ensuring the goals of economic growth and environmental pollution reduction.

This study provides some preliminary conclusions about the moderating role of institutional quality in the relationship between the shadow economy and environmental pollution, so there are still some issues that need to be considered in future studies. First, this study only considers time series data from one emerging country, further studies should be extended to developed countries to provide comparison and clear empirical evidence. Second, the panel data study and suitable estimation methods also need to be explored in future research. This may provide a more concrete insight into the role of institutional quality in the shadow economy and environmental pollution nexus. Finally, the development of theoretical models should be employed to further explore the relationship between the shadow economy and environmental pollution.

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