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The Role of Economic and Financial Developments for Environmental Quality in the ASEAN Economic Community (AEC)

Tuan Hock Ng, Chin Chew Low and Kar Hoong Chan
Faculty of Business, Multimedia University, Jalan Ayer Keroh Lama,
75450 Bukit Beruang, Melaka, Malaysia

Abstract: While economic development is probably top of mind for leaders of many developing countries, it is equally imperative for them to focus on greenhouse effect and global warming, mainly due to more economic outputs are often accompanied by energy use and a higher level of climate-warming pollutants. Not only that, financial development which is essential for economic development will give rise to substantial emissions of carbon dioxide (CO_2) due to energy use. Hence, it seems highly important to examine the effects of economic and financial developments on CO_2 emissions. This study, covers eight members of the ASEAN Economic Community (AEC) between 2000 and 2010. The random-effect model yields evidence that economic and financial developments have positive relationships with CO_2 emissions. Likewise, energy consumption has the expected positive effect on CO_2 emissions. These findings are relevant and useful to potential government policy.

Key words: Economic development, financial development, CO_2 emissions, ASEAN, relationships

INTRODUCTION

Managing environment is a burning issue worldwide, as pollution and climate change disturb the ecosystem and damage the lives and livelihood of human and animals. Many factors could have contributed to environmental degradation, the most likely being that of economic activities. As reported by the United States Environmental Protection Agency (EPA), human activities in relation to the combustion of fossil fuels for electricity, transportation and industry are dominant factors for a high level of climate-warming carbon dioxide (CO_2). Current available academic studies which place increasing emphasis on economy and environmental quality likewise concur on this argument, maybe that growth in production outputs not only entails consumption activities but also resource use such as energy (for example Georgescu-Roegen, 1971; Soytas and Sari, 2009) which likely lead to rising greenhouse gas emissions. As such while economic growth is probably top of mind for leaders of many developing countries, it is equally imperative for them to give more focus on climate change arising from increased greenhouse gases, primarily due to human activities.

In Asia, a more recent development is that of the launch of the ASEAN Economic Community (AEC) in 2015 which aims to form a single market that is fully integrated into the global economy (Association of Southeast Asian Nations. While ASEAN countries are not top emitter of greenhouses gases with greater economic expansion and integration, the region's primary energy requirements are expected to increase at 4.5% per annum from 2007-2030 as reported in the 3rd ASEAN Energy Outlook. As a consequence, the resulting CO_2 emissions will be at a 5.7% growth rate correspondingly.

That is to say, increasing greenhouse gas emissions will aggravate the problem of global warming. Along with this projection and the possible detrimental effects, crucial for leaders of ASEAN members is the timely response to manage environmental degradation issues. Nonetheless, environmental activists such as Greenpeace International and OxFam International were sending signals that ASEAN cooperation in climate change has yet demonstrated enough efforts to cope adequately with environmental issues. Their concern on environmental quality should ideally entail policymakers reviewing economic revolution and dealing with issues of environmental preservation; for instance greenhouse gases reduction and efficient energy consumption. For the purpose of driving transformation, sustainable economic development where the chase for economic growth may not be conflicting with environmental conservation (Barbier, 1987) is hence becoming increasingly important to avoid dangerous climate change.

Perhaps the key matter related to this issue is financial development. It is clearly recognised that financial development acts as both an opportunity and

Corresponding Author: Tuan Hock Ng, Faculty of Business, Multimedia University, Jalan Ayer Keroh Lama, 75450 Bukit Beruang, Melaka, Malaysia

initiative for developing countries to use new technology, resulting in environment-friendly production which brings about good environmental performance (Birdsall and Wheeler, 1993; Frankel and Rose, 2002; Tamazian *et al*., 2009). Therefore, higher levels of financial development likely reduce CO_2 emissions. However, debates on financial development and diminishing environmental health began surfacing and becoming a vital cause for concern recently. One such argument is that financial development is always accompanied by economic growth and energy use which tend to release a substantial amount of CO_2 into the atmosphere (Sadorsky, 2010, 2011; Zhang *et al*., 2011). As a result, continued neglect of the effect of financial development on environment will be costly errors and is certainly unhealthy for atmosphere in this context.

Against this backdrop, it seems highly important to examine the effects of economic and financial developments on CO_2 emissions for AEC member-nations via panel data estimation between 2000 and 2010. In addition, this study is motivated by the need to fill the research gap as only a handful of studies has attempted to establish a linkage between financial development and CO_2 emissions in particular for the ASEAN region. Incorporating these factors into CO_2 emissions will ensure a formulation of more effective policy measures that supports for the sustainability agenda in AEC members.

Literature review: The effect of economic and financial developments on environmental degradation forms an important question among policymakers and environmentalist. More specifically, this query remains contentious as empirical studies often produce mixed results. This section provides a brief review of studies pertaining to the role of economic and financial developments for CO_2 emissions.

While a country's booming expansion has been given first priority in emerging markets, economic development could compromise environmental degradation if left unaddressed. This is because economic activities which are closely dependent on the combustion of fossil fuels for electricity, transportation and industry (Sadorsky, 2010, 2011) accelerate the growth of CO_2 emissions (Soytas and Sari, 2009). In other words, higher economic development demands for energy use (Aqeel and Butt, 2001; Bartleet and Gounder, 2010; Saidi and Hammami, 2015) and subsequently results in high CO_2 emissions. This is particularly true for the early stages of development. However, following the Environmental Kuznets Curve (EKC) hypothesis, there will be a reduction in environmental damage after reaching a threshold of per capita income, mainly due to increased environmental awareness and new environmental regulations. As such, the link between economic growth and environmental pollutants is an inverted U-shaped function.

There seems to be an increasing body of literature that has examined the relationship between economic growth and CO_2 emissions with energy consumption. In a study by Apergis and Payne (2010) for 11 countries of the Commonwealth of independent states between 1992 and 2004, energy consumption has a positive and statistically significant long run effect on CO_2 emissions. Besides, their finding with regard to income and pollution supports the EKC hypothesis. Using 12 Middle East and North African (MENA) countries as their sample, Arouri *et al*. (2012) also showed that GDP has a quadratic relationship with CO_2 emissions. Likewise, a long-run relationship between CO_2 emissions, energy consumption and GDP was reported for Denmark, Germany, Greece, Iceland, Italy, Portugal and Switzerland (Acaravci and Ozturk, 2010). In China, Wang *et al*. (2011) similarly found that energy use and economic growth cause CO_2 emissions in a long run.

A country is seeing an increase in economic performance, in part due to financial development. As pointed out by Sadorsky (2010), financial development, which includes but is not limited to the expansion of the banking sector, increases in share market activities and more Foreign Direct Investment (FDI) plays an important role in escalating economy. The principal benefits derived from a more developed financial landscape for both entrepreneurs and households include an improved system for gaining an easier access to borrowed funds at a more affordable rate (Komal and Abbas, 2015). As a result of having more financial capital, consumers will start to purchase more energy consumable appliances, while business owners will expand the scale of operation (Furuoka, 2015; Shahbaz *et al*., 2013). This development in turn increases the demand for energy (Recognising that the empirical study related to the effect of financial development on CO_2 emissions is not only scant, but also remains a puzzle with conflicting results reported in the literature, this study reviews also researches that are relevant to the nexus of financial development and energy consumption (for example Sadorsky, 2011; Zhang *et al*., 2011); hence has adverse consequences for atmosphere. Particularly, in a study for 22 emerging markets, Sadorsky (2010) showed that financial development is positively related to energy consumption. Likewise, in his subsequent study, a similar result holds for Central and Eastern European countries (Sadorsky, 2011). With regard to the nexus between financial development and energy use, Mulali and Lee (2013) found

a long run positive effect of financial development on energy consumption in the Gulf Cooperation Council (GCC) countries. A similar result is also reported by Mulali and Sab (2012a, b) for Sub Saharan African and 19 developed and developing nations, respectively.

While there is a risk that financial development compounds climate change, it is arguable that financial development could be hailed as a solution to environmental degradation. Prior studies have provided evidence that financial development is good for environmental health. Current available studies, for instance, Tamazian *et al.* (2009), have stated that financial development offers opportunities to finance green infrastructure and investment projects at lower costs. Lending support to this, financial assistance facilitates technological innovation (King and Levine, 1993) and the use of efficient technology in turn relatively reduces energy consumption (Komal and Abbas, 2015; Kumbaroglu *et al.*, 2008). In this respect, financial development is expected to improve environmental quality. For example, using the random-effect approach, Tamazian *et al.* (2009) found that financial development is beneficial to environment in Brazil, Russia, India and China (BRIC). Likewise, financial development decreases CO_2 emissions in China. A negative relationship between financial development and environmental quality has also been reported by Shahbaz *et al.* (2013) for Indonesia.

In light of the above discussion, economic and financial developments matter for environmental quality but their effects on CO_2 emissions are highly contentious and hence inconclusive.

MATERIALS AND METHODS

Data: The main objective of this study, is to examine the effects of economic and financial developments on an air pollutant, namely CO_2 emissions. This empirical work is based on datasets obtained from the World Bank Open Data over the period of 2000-2010. Year 2000 is chosen as the starting year to coincide with the year of economic recovery after the Asian Financial Crisis in 1997.

The number of AEC member-countries in this study is limited to low and middle income countries for two reasons. First, financial development and economic growth are expected to be relatively more intensive in the early stage of development, leading to higher levels of energy use. As such, CO_2 emissions are expected to be more profound in developing countries. This is in line with Chang (2015) where energy consumption tends to increase with income in emerging economies. Second, with intent to enhance environmental quality, the selection of sample countries concurs on the issue that economic costs of controlling the atmospheric concentration of CO_2 will be lower with adoption of environmental-friendly policy measures in the early stage of development (Persson *et al*, 2006). Therefore, this study, focuses on developing countries in ASEAN (Two developed nations, namely Singapore and Brunei were excluded from further analysis) only. They are Indonesia, Malaysia, Cambodia, Myanmar, Philippines, Vietnam, Laos and Thailand.

Research model: Consistently following the studies by Tamazian *et al.* (2009) and Tamazian and Rao (2010), this study, adopts the random-effect modelling approach. As pointed out by Hsiao, this method is important to address the possible country-specific unobserved heterogeneity. The model specification is as follows:

$$CO_{2\,it} = \alpha + \beta 1 GDP_{it} + \beta 2 DEP_{it} + \beta_3 M_i + v_i + \varepsilon_{it} \quad (1)$$

where, CO_2 refers to CO_2 emission per capita in country i at time t; GDP_{it} which stands for GDP per capita growth rate in country i at time t is the proxy for economic development. As a measure of financial development, DEP_{it} represents the ratio of deposit money bank assets to GDP in country i at time t. M_i is a dummy variable with 1 denoting a middle-income country; v_i and ε_{it} indicates country-specific random effect and random error term, respectively.

Given that energy consumption is the primary factor that affects CO_2 emissions, Eq. 1 is re-estimated by including energy consumption as a control variable. In Eq. 2, ENG is defined as energy use (kilo of oil equivalent per capita) while the definitions of other variables remain the same as that for Eq. 1:

$$CO_{2\,it} = \alpha + \beta_1 GDP_{it} + \beta_2 DEP_{it} + \beta_3 ENG_{it} + \beta_4 M_i + v_i + \varepsilon_{it} \quad (2)$$

As a robustness check, Eq. (2) is re-examined with alternative definition of economic and financial developments. This is for the purpose of testing whether the regression coefficients are sensitive to alternative definition. This study uses industry share in GDP (IND) as a proxy for economic development. FDI, the degree of foreign direct investment in country i at time t is the substitute for DEP. The definitions of other variables are the same. Equation 3 is therefore formed as below:

$$CO_{2\,it} = \alpha + \beta_1 IND_{it} + \beta_2 FDI_{it} + \beta_3 ENG_{it} + \beta_4 M_i + v_i + \varepsilon_{it} \quad (3)$$

The definitions of variables are consistent with the study by Tamazian *et al.* (2009) and all data were transformed into a logarithm format.

RESULTS AND DISCUSSION

Table 1 displays the descriptive statistics for variables identified for eight AEC member-nations sampled in the period of 2000-2010. As reported in Table 1, the average of CO_2 emissions is 2.0705 (Mdn = 1.1887) with a standard deviation of 2.2368. The minimum value is 0.1617 while the maximum is 7.8096. In terms of GDP, the mean is 4.7181 (Mdn = 4.5753) with a standard deviation of 3.1985. GDP has a maximum (minimum) value at 13.1187 (-3.2430).

With regard to the industry share in GDP, the average is 36.6667 (Mdn = 38.2285, SD = 9.9760) and it ranges between 9.6922 and 48.5302. The mean of FDI is 3.1529 (Mdn = 3.1545) with a minimum of -2.7574 (Max = 10.0390) and standard deviation of 2.4549. Regarding the deposit money bank assets in GDP (DEP), Table 1 indicates an average of 60.9997 (Mdn = 44.0300), maximum (minimum) of 136.6600 (5.6200) with a standard deviation of 42.3550. As for energy consumption, the average is 865.9986 (Mdn = 461.1991) with standard deviation of 733.4999 ranging between 252.0370 and 2673.9940.

Table 2 reports the correlation statistic. The Pearson's correlation coefficient indicates that IND ($r = 0.8385$, $p<0.01$), DEP ($r = 0.8667$, $p<0.01$) and ENG ($r = 0.9515$, $p<0.01$) are highly positively correlated with CO_2. The positive sign implies that CO_2 emissions increase with higher levels of energy consumption, economic and financial developments.

Regarding the multicollinearity analysis, the strongest linear relationship among the independent variables is indicated by a correlation coefficient of 0.7810 between DEP and ENG. Statistically, this result indicates no serious case of multicollinearity among the variables.

The results for Eq. 1-3 on per capita CO_2 emission for a sample of AEC countries are presented in Table 3. Turning first to the issue on whether financial development affects CO_2 emissions, it is observed in Model 1 of Table 3 that DEP ($\beta = 0.3788$, $p<0.01$) significantly predicts CO_2 at the 0.01 level, implying that CO_2 emissions increase with a higher level of financial development. Although, a positive and significant coefficient is reported for the effect of financial development in this study, this finding is in contrast to studies by Tamazian *et al.* (2009) for BRIC countries and Jalil and Feridun for China to name a few. With respect to this contradictory conclusion, this study argues that financial development likely causes higher levels of energy consumption (for example, Mulali and Sab, 2012a, b; Aslan *et al.*, 2014; Chang, 2015; Coban and Topcu, 2013; Sadorsky, 2010) which produce larger amount of CO_2 consequently.

Increasing economic development seems to raise the emissions of CO_2. The sign for GDP ($\beta = 0.1044$, $p<0.01$) in the CO_2 emission regressions in Model 1 of Table 3 is positive. Several studies also highlighted a similar result where there is a positive relationship between economic development and CO_2 emissions, for example the studies by Azomahou *et al.* (2006) in a panel of 100 countries, Shahbaz *et al.* (2013) for Indonesia, Tamazian *et al.* (2009) for BRIC and Tang and Tan (2015) for Vietnam.

In Model 2, ENG was included in order to control the effect of energy consumption on CO_2 emissions. Likewise, the sign for DEP ($\beta = 0.3441$, $p<0.01$) GDP ($\beta = 0.0926$, $p<0.01$) is positive respectively as expected even under conditions of energy consumption.

The empirical results with respect to the robustness check are similar to the results presented in Model 2. FDI ($\beta = 0.0494$, $p<0.05$) as an alternate for DEP is positive in

Table 1: Descriptive statistics

Variables	CO_2	GDP	IND	FDI	DEP	ENG
Average	2.0705	4.7181	36.6667	3.1529	60.9997	865.9986
Median	1.1887	4.5753	38.2285	3.1545	44.0300	461.1991
SD	2.2368	3.1985	9.9760	2.4549	42.3550	733.4999
Min.	0.1617	-3.2430	9.6922	-2.7574	5.6200	252.0370
Max.	7.8096	13.1187	48.5302	10.0390	136.6600	2673.9940

Table 2: Correlation of variables

Variables	CO_2	GDP	IND	FDI	DEP	ENG
CO_2	1.0000					
GDP	0.0640	1.0000				
IND	0.8385***	-0.0355	1.0000			
FDI	0.1077	0.4668	-0.0097	1.0000		
DEP	0.8667***	-0.0259	0.6682***	0.0685	1.0000	
ENG	0.9515***	0.0512	0.7003***	0.1756**	0.7810***	1.0000

The asterisks ***, ** and * denote significance values at 1, 5 and 10%, respectively

Table 3: Regression analysis

	Coefficient		
Variables	Model 1	Model 2	Model 3
Constant	-2.6090***	-7.9195***	-9.2932***
	(0.3941)	(0.0809)	(0.7467)
GDP	0.1044***	0.0926***	
	(0.0304)	(0.0269)	
DEP	0.3788***	0.3441***	
	(0.0314)	(0.0259)	
M	1.5923***	0.5955***	0.8653***
	(0.2526)	(0.0859)	(0.1576)
ENG		0.9560***	1.0722***
		(0.0187)	(0.0694)
IND			0.4993*
			(0.2725)
FDI			0.0494**
			(0.0218)

[a]The asterisks ***, ** and * denote significance values at 1, 5 and 10%, respectively; [b]Countries under consideration is subject to data availability. In parentheses is the standard error; F-statistic[a]: 29.7234***, 626.1785***,203.7343***; Adjusted R^2: 0.5094, 0.9723, 0.9237; [c]No. of observations: 84, 72, 68

Model 3. Economic development as measured by IND ($\beta = 0.4993$, $p<0.10$) is similarly positive and significant at the 0.10 level.

Regarding the effect of energy consumption, the results of Model 2 and 3 in Table 3 show that ENG is positive and significant at the 0.01 level respectively. These results imply that higher levels in energy use increase CO_2 emissions. A similar result has been reported by Shahbaz *et al*. (2013), Tang and Tan (2015) and Tamazian *et al*. (2009). The results for country income group in AEC, proxied by the binary variable with one for middle-income countries, otherwise zero, show that middle-income countries are related to higher levels of CO_2 emissions across the three models. This finding concurs with the study by Chang (2015) who highlighted that energy use increases with income in emerging economies.

CONCLUSION

With the establishment of the AEC in 2015, perhaps it is most important to be well prepared for climate change as rapid economic expansion is likely accompanied by a higher level of climate-warming pollutants, for example CO_2 emissions. Given this concern, this study attempts to determine whether economic and financial developments lead to environmental degradation in AEC member-countries during the period of 2000-2010.

The empirical results show that financial development escalates the emissions of CO_2 in the ASEAN region. When controlled for energy consumption, the positive and significant coefficient on financial development remains the same. Regarding this finding, an important development must be the emphasis of well-planned financial development, especially with the prospect of financial integration among ASEAN member-nations.

Policymakers must emphasise green financial development to deal with climate change such as the incentive schemes under green technology financing plans that encourage the adoption of clean technologies. Besides, governments and the banking sector should work closely to promote green projects in order to produce a less carbon-intensive economy.

In addition, the random-effect model yields evidence of a positive relationship between economic performance and CO_2 emissions. In this sense, ACE leaders need to weigh the fact that economic activities can have a negative effect on environment and should take responsibility for economic planning and environmental well-being in a long run. Notable measures that can be specifically drafted to support green growth include more efficient energy policies, the adoption of clean energy technologies, and provision of incentive for the use of less carbon-intensive infrastructures. Closer cross-border collaboration among AEC members and more proactive regulatory interference are needed to enable the economic system sustains and functions well with no compromise on environmental safety.

As a conclusion, regulators and policymakers should strive to manage climate change issues and national development, making environmental management a must-do agenda in their administration.

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