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ECONOMIC STRUCTURAL TRANSFORMATION AND CO_2 EMISSION IN ASIAN COUNTRIES: HOMOGENEOUS VS. HETEROGENEOUS ESTIMATORS

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***Abstract:** This study examines the impact of structural transformation on environmental pollution in selected Asian countries for the years 1990-2016. This transformation decomposes into sectoral compositions, urbanization, and demographic changes in Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT) model and estimates using the panel model that under the homogeneous slope assumption and also accounts for heterogeneity across countries. The study has sorted out the problem of cross-sectional as well as the heterogeneity in Asian countries and suggests the prime catalyst of CO_2 emissions is the brisk industrialization, urbanization rate and economic development. Further, this finding also support the existence of an inverted-U curve between affluence level and CO_2 emissions and urbanization and CO_2 emissions, implying that at a higher scale of the economy and higher urbanize level, CO_2 emissions decrease but this remained inconclusive in the heterogeneous panel. This study provides policymakers with clear picture on how to promote growth in achieving the sustainability development policy.*

Keywords: *Structural Transformation, CO_2 Emissions, Panel Model, Asian Countries*

Introduction

Looking back in 1990, the CO_2 emissions fell significantly in Europe and projected to continue to decrease in Europe up to 2050, however in Asian it is still continued to grow (OECD, 2012) and moreover, to date it accounted for more than 50% of the global anthropogenic emissions of global anthropogenic (Behera and Dash,2017). As we look into the previous and recent global trends scale,CO_2 emissions grew by 58% between 1990 and 2014, nevertheless a slowdown in annual growth rates of global CO_2 emissions since 2012 due to a structural change from carbon-intensive and high value-added manufacturing industry economy to less carbon-intensive activities (Olivier *et al*., 2016).

Referring to Figure 1 that shows the changes of CO_2 emissions per capita in Asian during 1990 and 2010, interestingly, highly urbanized country like Singapore shows a sharp drop in the CO_2 emission. On the other hand, the developed countries such as Japan experiences very little change in the emissions. The overall trends indicate that Asian countries only experiencing minor changes in CO_2 emissions excepts in high and upper middle income such as China, Malaysia, Korea and Taipei which showed that there are significant increase trends in the CO_2 emissions.

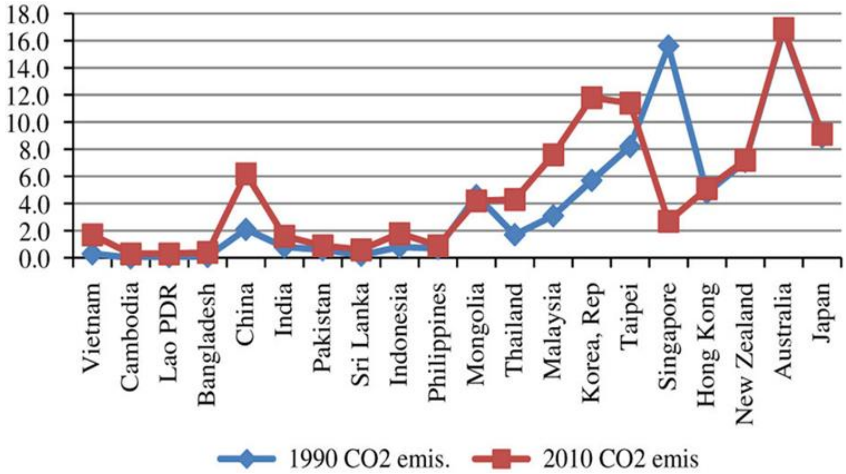

Figure 1: Changes in CO_2 Emissions Per Capita in Asian During 1990 And 2012
Source: Ota (2017)

Historically, structural change said to influence the economic development in two ways. First, the structural transformation from agricultural to industrial production, which also known as industrialization process that induced higher scale of production and caused pollution emissions to rise (Nejat *et al.*, 2015). Second, the transition of industrial-based production to services-based which also known as the tertiarization and promotes an increasing share of less polluting sectors in the economy and reduces pollution emissions. This theory basically based on Three-Sector Analysis[1]. Eurostat (2014) reported that this situation happens as the level of awareness regarding the effect of environmental pollution increase. As such, people will demand more for services such as healthcare, education, security, and better places to stay. The Environmental Kuznet Curve (EKC)[2] hypothesis also argues to be associated with the structural change. Although, past studies show that structural change is less significance to explain the EKC hypothesis (see Kander, 2000), as stated earlier, sign of a permanent slowdown in the global CO_2 emissions registered in 2012-2015 due to expansion of services sector re-opened the debates. Nonetheless, the structural change in production alone cannot explain the pollution trends (Hamilton, 2000). According to Timmer (2012), the structural transformation process consists of four interrelated processes: first, the industrialization process; second, the rise of service economy; third, and the rapid process of migration to urban area and fourth a demographic change in age composition. Moreover, it is projected that in

[1] As income rises, the economy moves from primary sector (agriculture-based) to the secondary (industrial-based), and the pollution level will increase. Afterward, when a country becomes more prosperous, the economy moves to the tertiary sector (services-based), environmental pollution should be decreased(Linden and Mahmood, 2007; Dinda, 2004; Alam, 2015)

[2] The Environmental Kuznets Curve (EKC) was initially a doctrine by the American economist Kuznets (1976) that analysed the relationship between the level of income per capita and the degree of inequality in the 1950s .The EKC is an inverted U-shaped curved that depicts a concave relationship between per capita GDP and environmental degradation.

2050 a country that experiences fast growth of urbanization and aging population, mostly in Asian countries such as China likely to outstrip the benefits of any emission reductions (OCED, 2012).

According to Lanzafame (2014) the pace of structural transformation has differed widely across Asian countries, but most of the empirical studies treated the panel into homogenous (Alam, 2015), the CO_2 emissions generally known to affect another countries, thus to assume that countries in the same region is cross-section independence is quite unrealistic (Sohaq *et al*., 2017). As Asian countries undergoing another major structural transformation (Green and Stern, 2016), this study aims to assess the general impact of structural transformation proxies by sectorial share, urbanization and demographic change on CO_2 emissions using homogenous and heterogeneous estimators which allow for several estimation bias such as cross-sectional dependence and heterogeneity across Asian countries. On the other hand, this study also intended to observe the structural transformation effect in non-linear model or specifically based in the well-known theory of growth-pollution nexus so-called Environmental Kuznets Curve (EKC).
The specific objective of this study is:

1. To examine the impact of structural transformation on environmental pollution in selected Asian countries for the years 1990-2016 in linear and non-linear framework.

The remaining of this study is organized as follows. First, in section 2, several related literature that discusses the impact of structural transformation on environmental pollution discussed. Next, the methods used in estimating and analyze the effect of structural transformation factors on environmental pollution highlighted in Section 3. Then, the results estimated will be discussed in Section 4 and conclude in section 5.

A Brief Review of the Literature

Most studies in the field of EKC-three sector analyses nexus majority focused on industrialization process. Cherniwchan (2012) adopted a neoclassical growth model of two-sector model for small open economies covering about 157 countries from 1970 to 2000 to assess the association between growth in the context industrialization process and environmental pollution. His study shows that the industry has a positive significant effect on the pollution emissions. Meanwhile, Li and Lin (2015) believed that the impact of industrialization varies with countries' income levels. Using the STIRPAT framework, they had found out that only in the middle and low-income countries, the industrialization found to positively relate with the CO_2 emissions, while industrialization has an insignificant impact toward the high-income group.

The positive association between urbanization and CO_2 emissions are also confirmed by a numerous studies. Azam, M. and Khan, A. Q. (2016) adopted the least squares method in Bangladesh, India, Pakistan, and Sri Lanka over the period of 1982 to 2013 and found out that the relationship between urbanization and environment is significantly negative in Bangladesh, nevertheless it is significantly positive in the case of Sri Lanka and insignificantly positive for Pakistan. In contrast, Poku (2016) adopted the heterogeneous panel estimators and found that that the expansion of urbanization is significantly increases CO_2 emissions in the short–run as well as in the long-run for 45 Sub-Saharan African (SSA) countries from 1990-2010.

In population aging-pollution nexus studies, Liddle and Lung (2010) focused on 17 developed countries from the period of 1960 until 2005 and found that the aging population was negatively related to CO_2 emissions. In contrast, Menz and Welsch (2012), found that the population aging has a positively effect on pollution emissions in OECD countries spanning the period 1960 to 2005. A more recent study by Hassan and Salim (2015) using a panel data over 1980-2009 for 25 high-income OECD countries shows that rises in the share of the aging population will decrease the CO_2 emissions in the long run.

Turing to the pollution-income nexus, Mazur *et al.*, (2015) employed the static panel estimators to assess the validity Environmental of Kuznets Curve (EKC) in new EU members and found that there are no U-shaped EKC for all 28. This supported also by Kasman and Duman (2015) for the period 1992–2010 in the European Union countries. On the other hand, some study also extended the EKC model into a cubic term. Başar and Temurlenk (2007) who analyse the association between CO_2 and income in Turkey for the years 1950-2000 and confirmed an inverted N shape association between CO_2 and income, and CO_2, nevertheless Omay (2013) found that there are N-shaped association between CO_2 emissions and income in Turkey for the period 1980-2009.

The above review of literatures proves that the argument of the structural transformation-pollution framework found to be inconclusive. This study aim to fill the gaps of existing studies. First, the structural transformation generally assess to sectoral composition, nevertheless this study include other variables such as urbanization and aging population. Second, instead of examining the EKC hypothesis merely the income - $\mathrm{CO_2}$ emissions nexus, this study also include the non-linear relationship between urbanization and $\mathrm{CO_2}$ emissions. Third, by taking Asian as the focus study, existing study that take consideration of the heterogeneity and cross-dependency among country rather scarce. Thus, in view of the importance of the heterogeneity and cross-dependency factors, this study also will accounts for heterogeneity and cross-dependency across countries in panels.

Theoretical Background and Model Construction

This paper analyses the decomposed factor that affects the environment based on Stochastic Impacts by Regression on Population, Affluence and Technology (STIRPAT)[3] model (Wang *et al.*, 2016).

$$I_{it}=a_i P_{it}^{b} A_{it}^{c} T_{it}^{d} e_{it} \quad (1)$$

Where, I_{it} is pollution, $\mathrm{P_t}$ is population, $\mathrm{A_t}$ is affluence, $\mathrm{P_t}$ is technology and e_{it} is the error term. All the series are transformed into natural log form. Due to the use of panel estimation, countries are represented by the subscripts i (*=1,….,N*) and time period are denoted by the subscripts t (t=1,….,T); a_i denote the country-specific effect and e_{it} represents the random error term. The elasticities for the following variable can be represented by b, c and d. The model is interpreted based on the estimates coefficients (b, c, d). For this paper, the STIRPAT model is extended to include structural transformation effect on pollution as proposed by Timmer (2012), sectoral shares (Alam, 2015), urbanization (Poumanyvong and Kaneko, 2010; Sadorsky, 2014), and aging population which is used as a proxy for demography changes (Menz and Welsch, 2012). Taking natural logarithms of equation (1) provides a linear specification in panel estimation and is designated as **Model 1**.

$$\mathrm{InZ_{it}} = \beta_1 In\mathrm{I_{it}} + \beta_2 lnS_t^{\ r} + \beta_3 lnG_t + \beta_4 In\mathrm{U_{it}} + \beta_5 In\mathrm{pop65_{it}} + \alpha_\mathrm{i} + \varepsilon_\mathrm{it} \quad (2)$$

Model 2 includes the impact of trade openness as proposed by Ameer and Munir (2016):

[3] Initially introduce as IPAT by Erlich and Holdren (1971)

$$\text{InZ}_{it} = \beta_1 In\text{I}_{it} + \beta_2 lnS_{it}{}^{r} + \beta_3 lnG_{it} + \beta_4 In\text{U}_{it} + \beta_5 lnpop65_{it} + \beta_6 lnTO_{it} + \alpha_i + \varepsilon_{it} \quad (3)$$

Equations 2 and 3 indicate that environmental impact (Z_{it}) proxy by CO_2 emission influence by technology which is proxy by energy intensity (I), affluence is proxy by GDP per capita(G), population effect proxy by urbanization intensity (U), and aging population (POP65). We include structural change effect that is proxy by the sectoral share of value added (S) and trade openness (TO).The combined effect of all the above factors on environmental pollution can be represented by a linear specification for panel estimation where countries are denoted by the subscript i (i = 1,…, N), and time is denoted by the subscript t (t = 1,…,T).Country-specific effects is included through α_i , and ε_{it} represents the random error term.

The current study extends the STRIPAT model within the Environmental Kuznets Curve (EKC) hypothesis framework model based on the model proposed by Ameer and Munir (2016) and is designated as **Model 3.**

$$\text{InZ}_{it}=\beta_1 In\text{I}_{it}+\beta_2 lnS_{it}{}^{r}+\beta_3 lnG_{it}+\beta_4 lnG_{it}{}^{2}+\beta_5 In\text{U}_{it} + \beta_6 lnTO_{it} + \beta_7 lnPOP65_{it} + \alpha_i+\varepsilon_{it} \quad (4)$$

$\boldsymbol{G_t}^{\mathbf{2}}$ is the squared of GDP per capita represent the affluence accumulation effect on pollution, and provides the possibility of a non-linear relationship. According to EKC theory, it expected that squared GDP per capita will moderate the pollution effect.

This paper also extends the urbanization effect as proposed by Shahbaz *et al*., (2017) to allow the expansion of urbanization accumulation effect, and it is designated as **Model 4** *in* equation (5)

$$\text{InZ}_{it}= \beta_1 In\text{I}_{it}+\beta_2 lnS_{it}{}^{r}+\beta_3 lnG_{it}+\beta_4 In\text{U}_{it} + \beta_5 In\text{U}_{it}{}^{2} + \beta_6 lnTO_{it} + \beta_7 lnPOP65_{it} + \alpha_i+\varepsilon_{it} \quad (5)$$

$\boldsymbol{U_t}^{\mathbf{2}}$ is the squared and cubic terms in a model of urbanization. The squared term allows the expansion of urbanization accumulation effect on pollution emission and it includes the consideration of the possibility of a non-linear relationship.

Econometric Approach

To accomplish the objective of this paper, we adopted a panel data from 35 Asian countries for the period ranging from 1990 to 2016. This study estimates the impact of structural transformation on pollution emission across countries under the homogeneous slope assumption and also accounts for heterogeneity across countries and non-stationarity in panels. The finding from the homogeneous parameter estimation methods later compares with the finding from the heterogeneity estimation procedures to increase the robustness of the finding as proposed by Sadorsky (2014). In homogeneous estimator, this paper opt the fixed-effect regression with Driscoll-Kraay (1998) standard error to overcome the cross-sectional and temporal dependencies. This study also adopted the macro panel estimators (hereafter known as heterogeneous panel estimators) which allow for unobserved cross-sectional dependence, parameter heterogeneity across cross-sectional units, omitted time-invariant unobservable, and non-stationarity (Pesaran and Smith, 1995; Pesaran, 2006; Eberhardt and Teal, 2010; Eberhardt, 2012). Three different heterogeneous estimators[4] that consider the cross-section

[4] The mean group estimator, the correlated effect mean group (CCEMG) and Augmented mean group (AMG) estimators developed by Pesaran and Smith(1995), Pesaran(2006) and Eberhardt, and Teal (2010), respectively.

dependence in each entity that restricted to the non-dynamic panel. All the estimators allowed heterogeneity in the parameters and cross-sectional dependence (Kapetanios *et al.*, 2011).

Estimation Results

First, the diagnostic test employs to tests the problem of serial correlation and the present of that heteroscedasticity, as reported in Table 1. Next, this study adopted three tests identifying for cross-sectional dependence that exists in data. The results indicates that it is important of taking into account the cross-sectional dependence when analysing the Asian countries panel especially when the inclusion of square value of the independent variable to check for non-linearity of the model as reported in Table 2. Moreover, the result suggests that the error structure is assumed to be heteroskedastic and auto-correlated due to possibly correlated between the groups (Hoechle, 2007).

Table 1: Diagnostic Tests

Model	1	2	3	4
Wooldridge test	18.84***	18.80***	18.51***	18.51***
Modified Wald	4044***	3736***	1206***	1208***

Note: (*) significant at the 10 per cent level, (**) significant at the 5 per cent level, and (***) significant at the 1 per cent

Table 2: Cross-Sectional Dependence Tests

		Pesaran CD test	**Frees CD(Q) test**	**Freidman CD test**
MODEL 1	FE	0.907	0.907*	18.895
	RE	0.854	7.991*	19.323
MODEL 2	FE	0.754	7.726*	18.263
	RE	0.758	7.594*	19.079
MODEL 3	FE	0.462	7.321*	26.506*
	RE	1.988**	0.208*	43.493
MODEL 4	FE	0.656*	7.123*	26.025*
	RE	1.871*	0.174*	44.028*

Note: FE and RE denote fixed and random effect estimations. (*) significant at the 10 per cent level, (**) significant at the 5 per cent level, and (***) significant at the 1 per cent

In order to obtain a convincing result, model 1-4 will be examined with the fixed-effect estimation with Driscoll-Kraay (1998) standard error which is robust to heteroscedasticity across panels, serial correlation and cross-sectional-dependence within panels. The empirical results for the models using the homogeneous estimators based in Driscoll and Kraay Standard Errors are presented in Table 3.

Models (1) and (2) indicate that affluence effect, industrialization, tertiarization, and urbanization exert statistically significant positive effects on CO_2 emission. On the other hand, the technology effect is statistically negative related to CO_2 emissions. The inclusion of trade openness as proposed by Ameer and Munir (2016) as in model 2 found significant negatively related to CO_2 emission. On the other hand, ageing population found to be not significant in influencing the CO_2. The model (1) and (2) explains 54 and 55 per cent respectively of the cross-country variation.

Turning to the regression results for environmental pollution and structural transformation determinants within the EKC Hypothesis. In the estimation with Driscoll-Kraay (1998) standard error, the affluence-emissions nexus and urbanization-emission found to have inverted U-shaped relationship with statistically significant at 1 per cent level. This implied that the positive effect affluence and urbanization negative effect is not permanent. The sectorial change proxy by industrialization confirmed to statistically increase the CO_2 emissions, while tertiarization exerts statistically significant positive effects on CO_2 emission only in model (3) but has a small impact compare the industrial activities. On the other hand, the technology effect and trade openness are statistically positive and negative related respectively to the CO_2 emissions. The ageing population found to be not significant in influencing the CO_2. The model (3) and (4) explains 76 and 69 per cent respectively of the cross-country variation.

Table 3: The Impact of Structural Transformation on CO_2 Emissions In Fixed-Effect (Within) Regression With Driscoll And Kraay Standard Errors

	MODEL 1	MODEL 2	MODEL 3	MODEL 4
G	0.089* (0.046)	0.080* (0.044)	3.64*** (0 .095)	0.160*** (0.030)
G^2	-	-	-0.202*** (0.010)	-
$\ln S^i$	0.103** (0.044)	0.109** (0.045)	0.141** (0.030)	0.129** (0.027)
lnS^s	0.051* (0.027)	0.053** (0.024)	0.042* (0.022)	0.005 (0.015)
U	0.023*** (0.002)	0.023*** (0.002)	0.018*** (0.001)	0.110*** (0.010)
U^2	-	-	-	-0.078*** (.052)
POP65	0.011 (0.008)	0.012 (0.007)	0.005 (0.006)	0.006 (0.007)
I	5.86*** (0.860)	5.73*** (0.828)	6.870*** (0.640)	5.940*** (0.637)
TO	-	-0.057*** (0.018)	-0.080*** (0.012)	-0.025** (0.018)
R-squared	0.540	0.550	0.670	0.690

Notes: Regression with Driscoll-Kraay standard errors, reported in parenthesis. R^2 are within for fixed effects. (*) significant at the 10 per cent; level, (**) significant at the 5 per cent level, and (***) significant at the 1 per cent level.

Next, the heterogeneous estimators such as MG, CCEMG, and AMG adopted and the results are presented in Table 4. In MG, CCEMG, and AMG estimations, the affluence effect confirmed to positively influence the CO_2 emissions in both MG and AMG estimators but not in CCEMG model. Nevertheless, the square term of affluence effect is not follow the inverthed U-shaped as shown in homogenous estimators.

Meanwhile, the sectorial change proxy by industrialization found to statistically positively significant explaining the CO_2 emissions, while tertiarization effect produces inconsistent result in heterogeneous estimators. The tertiarization proses has negative association with the CO_2 emissions in model 1 and 2, nevertheless, found to positively related in model 3 and 4.

Turning to the urbanization effect, the urbanization also confirmed to positively relate to CO_2. However, as the urbanization increases further as proxy by square term as in Model 4, it bound to reduce the carbon emissions. On the other hand, the aging population and trade openness show to not statistically significant in all models.

Homogeneous Vs. Heterogeneous Estimators

In comparing the homogenous and heterogeneous estimators, the existence of an inverted-U shaped between GDP per capita and CO_2 emission in our findings are consistent with numbers of studies (see Hassan *et al*., 2015; Nejat *et al*., 2015), however, it is not consistent with the country specific is included. This implied that, the pace of development has differed widely across Asian countries

Meanwhile, the positive signed of industrial and services sector value added in line with Alam (2015). However, the mixture results in tertiarization in heterogeneous collaborated with Sohag *et al*., (2017). According to Sohag *et al*., (2017), the dissimilarities effect of the growth of services on CO_2 emissions due to different income level; positive effect registered in high income and middle countries but negative related in low-income countries.

Next, the inverted U-shaped of urbanization-pollution nexus in lined with Rafiq *et al*.,(2017) which both found in homogeneous and heterogeneous estimators. The expansion of urbanization accumulation proxy by the square of urbanization found to support the theory of ecological modernization and urban environmental transition theory since it determines an inverse relation between urbanization and environmental pollution.

The insignificant effects of population aging are not consistent with Hassan and Salim (2015). Similarly with previous study such as Niu *et al*., (2011) and Ameer and Munir (2016), the technology effect proxy by energy intensity is positively related to CO2 emissions. Finally, the association between trade openness and environmental pollution is accordance with the recent study by Case and Sami (2016) and Ozturk *et al*., (2016).

Conclusion and Discussion

The main objective of this paper is to evaluate the impact of structural transformation on CO_2 emissions. The finding has sorted out the problem of cross-sectional as well as the heterogeneity in Asian countries which increase the robustness of this finding.

To sum up the result from both homogenous and heterogeneous estimations, this study found that the prime catalyst of CO_2 emissions is the rapid process of industrialization, urbanization and economic development. Nonetheless, the quadratic term shows confirmed the inverted-U shaped relationship between GDP per capita and CO_2 emissions as well as the relationship between urbanization and pollution. Marsiglio (2016) stated that there are three main reasons for the inverted-U shape relationship; advancement to environmental friendly technological innovation; an increase in the awareness for environmental protection activities; changes in the economy structure which may shift economic production system from high polluting industry to low polluting services.

On the other hand, the ecological modernization theory argue that high urbanization may induce society to emphasize on the environmental sustainability, technology innovation, and structural transformation from extensive-polluting sector to less-polluting sectors such as services sector.

Next, the industrial and services activity contributes to carbon dioxide emission. The industrial sector generally employ the traditional capital-driven production technique which consequently increase the CO_2 emissions (Shafik and Bandyopadhyay, 1992; Shahbaz *et al*., 2014). Meanwhile, according to Dutta, M. (2005) industrialization is interrelated with the expansion of services sectors and the actual role of the tertiary sector in promoting cleaner environment still in large debates.

This study also concludes that trade that rising in trade activities moderate the global. This result strengthens the prominent explanation by Torras and Boyce (1998) on trade openness where when the polluting sector produces lesser and import from other country but when the polluting sector focusing on producing more to export to another country the pollution level will increase. This mixture finding may occur due to varying level of income across countries in Asian countries as shown in the previous study such as Abdulai and Ramcke (2009). Moreover, the levels of environmental regulations and demand for environmental quality are different among Asian countries which directly or indirectly depend on the level of income.

We suggest policy implications emerging from our study are as follows. First, in terms of production, the continuous increase in carbon-intensive activities and industrialization may drive increase carbon dioxide emissions of Asian countries. Therefore, countries are recommended to embrace more sustainable development policies to promote structural shifts away from carbon-intensive activities to low carbon energy mix and to design and improve pollution control technologies. Hence, it is suggested that Asian countries with a lower level of services share should speeding up the process of tertiarization, however, an efficient services delivery in achieving low carbon-driven sustainable environment-friendly economic growth in long-run is required. Second, the results suggested that Asian countries with a lower level of urbanization should speeding up the process of urbanization so as to encourage the fast development of urban cities and changes the economy and society structures, however, governments should pay extra attention on the over-concentration in the largest city. A proper design for sustainable lifestyles for urban population is needed in Asian countries. Other than that, less urbanized and developing countries should refer to urban policy from other developed and highly urbanize country as references such as Singapore.

Third, stringent environmental regulations and policies on the trade that affect the environment are crucial. Therefore, the policy maker should design policy that can encourage more environmental friendly goods inflows and enforce environmental laws specially when handling the entry of foreign firms. On than that, several incentives such as granted a tax exemption to local and foreign firms that invests in environmental friendly projects.

Finally, the environmental awareness in societies should start for the early human development and education as ignoring it will cause the environmental problem multiple from generation to generation (Ozokcu and Ozdemir, 2017). Thus, the government should attach importance and reasonable blueprint in providing of efficient services, education, and strategies that beneficial to all level of aged which lead to an energy saving activities.

Table 4: The Impact of Structural Transformation on CO_2 Emissions in Heterogeneous Parameter Estimation

VARIABLE	MODEL 1			MODEL 2			MODEL 3			MODEL 4		
	MG	**CCEMG**	**AMG**	**MG**	**CCEMG**	**AMG**	**MG**	**CCEMG**	**AMG**	**MG**	**CCEMG**	**AMG**
G	0.598*** (0.221)	0.061 (0.230)	0.535*** 0.193	0.432** (0.204)	0.054 (0.152)	0.601*** (0.213)	0.424* (3.93)	-0.733 (8.44)	5.590** (4.600)	0.401** (0.199)	0.039 (0.168)	0.453** (0.194)
G^2	-	-	-	-	-	-	-0.050 (0.250)	0.156 (0.483)	0.302 (0.273)	-	-	-
$\ln S^i$	0.159** (0.052)	**0.**130** (0.022)	0.121 (0.048)	0.258** (0.036)	0.134** (0.036)	0.437** (0.032)	0.018 (0.030)	0.021 (0.034)	0.026 (0.025)	0.078** (0.034)	-0.034 (0.028)	0.073** (0.032)
lnS^s	-0.026* (0.031)	-0.002* (0.040)	-0.012** (0.020)	-0.066* (0.032)	-0.015* (0.047)	-0.007** (0.016)	0.014 (0.031)	0.033** (0.032)	0.002 (0.023)	0.029 (0.023)	0.016 * (0.028)	0.022* (0.023)
U	0.043** (0.018)	**0.**001 (0.044)	0.015** (0.018)	0.041** (0.017)	0.006 (0.033)	0.012 (0.018)	0.026** (0.013)	0.031** (0.043)	0.014 (0.012)	0.130 (0.368)	0.575** (0.771)	0.010** (0.450)
U^2	-	-	-	-	-	-	-	-	-	-0.005* (0.003)	-0.003 (0.007)	-0.001* (0.003)
POP65	0.056 (0.084)	-0.012 (0.106)	0.014 (0.096)	0.046 (0.074)	-0.044 (0.064)	0.014 (0.087)	0.012 (0.068)	0.151 (0.142)	0.035 (0.078)	0.026 (0.079)	-0.029 (0.191)	0.064 (0.075)
I	2.200 (2.030)	5.44*** (1.60)	1.87 (1.93)	2.44 (1.90)	4.92*** (1.64)	3.07* (1.81)	1.52 (2.02)	4.35** (1.82)	2.29 (2.31)	2.84 (2.10)	3.58** (1.81)	3.62* (2.10)
TO	-	-	-	0.015 (0.008)	-0.004 (0.007)	0.066 (0.075)	.001 (.007)	-0.009 (0.007)	-0.001 (0.003)	0.009 (0.001)	-0.003 (0.009)	0.082 (0.004)
Wald χ2	(0.018)	(0.037)	(0 .132)	(0.010)	(0 .139)	(0 .064)	(0.619)	(0.352)	(0.621)	(0.060)	(0.560)	(0.051)
RMSE	0.181	0.100	0.142	0.083	0.087	0.137	0.165	0.083	0.131	0.171	0.077	0.132
Obs	918	918	918	918	918	918	918	918	918	918	918	918

Notes: Elasticities are based on Pesaran and Smith (1995) mean group estimator (MG), Pesaran (2006) common correlated effects mean group estimator (CCEMG), and augmented mean group estimator (AMG) was developed in Eberhardt and Teal (2010). Standard error is provided in the parenthesis. For Wald χ2 tests p-values are provided in the parenthesis.

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