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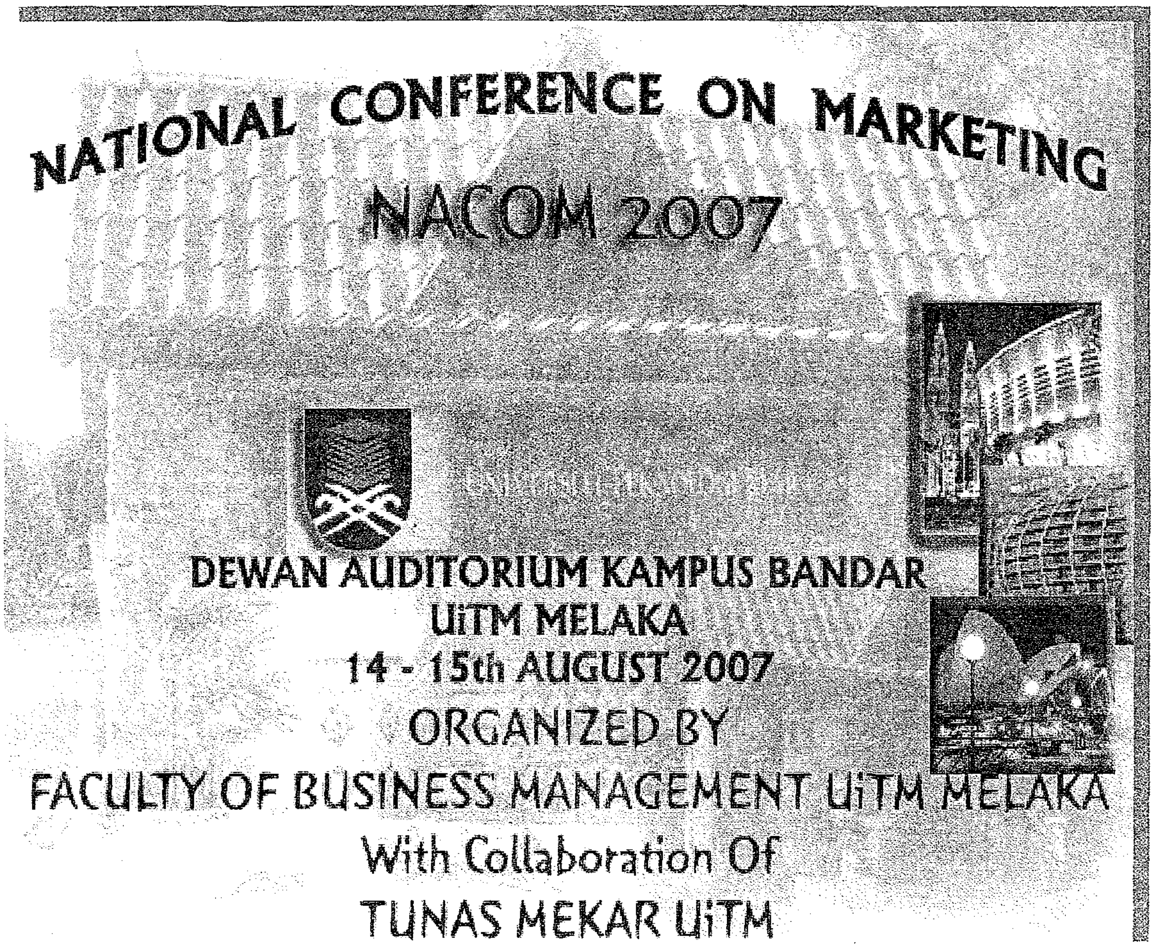
Air Pollutants And Economic Growth In Malaysia: A Simultaneous Estimation Of The Environmental Kuznets Curve



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AIR POLLUTANTS AND ECONOMIC GROWTH IN MALAYSIA: A SIMULTANEOUS ESTIMATION OF ENVIRONMENTAL KUZNETS CURVE

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ABSTRACT

This study attempts to examine the relationship between environmental degradation to economic growth in developing countries by taking into account the environmental Kuznets curve. The focus on environmental degradation is on air pollution in Malaysia. This study attempts to measure the actual shape of Environmental Kuznets curve (EKC) in response to modern environment regulation in Malaysia. The EKC relationship has usually been used as a theoretical model to represent the change in pollution levels in a city over time as economic development proceeds. As Grossman (1995) first suggested, it is possible to distinguish three main channels whereby income growth affects the quality of the environment. Firstly, a scale effect, secondly a composition effect and thirdly, technological progress. A recent research criticism of the environmental Kuznets curve hypothesis is based on the occurrence of foreign direct investment and international trade (Cole, 2003 and 2004). The general objective of this study is to measure the relationship between economic growth and different indicators of air pollution in Malaysia. Air pollution indicators were assessed on a number of measures: Carbon Monoxide (CO), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O_3), Particulate Matter (PM_{10}) and Suspended Particulate Matter (SPM). The income level per capita GDP (Gross Domestic Product) per capita were measured from the year 1996 to 2006. In the EKC literature, EKC is always estimated in the form of a single equation. However, since both income and environmental quality are endogenous variables in which they impact upon each other, therefore the estimation of single equation relationships where simultaneity exists will produce biased and consistent estimates. This study specify the channels through which the income affects pollution and pollution affects income in a conceptual model and then formulate a two-equation simultaneous model for empirical research. This study test for exogeneity with the Hausman test and estimate the simultaneity model using the two-stage least squares method.

Keywords: Air Pollutants, Economic Growth, Malaysia, Environmental Kuznets Curve, Simultaneity

INTRODUCTION

Natural resource and environmental degradation, and resulting economic, social impacts are often viewed as a problem unique to developing countries. Environmental issues ought to be an important area of concern for leaders and policy makers, when making policy decisions about human development and economic welfare, especially those in developing countries. Many growth sectors are in effect directly or indirectly related to the environment. Environmental degradation comprises of the following key areas; soil erosion, exploitation of open access resource due to ill-defined property rights, congestion and traffic, population and poverty. (Forum for Economics and Environment – Training Manual) This study attempts to examine the relationship between environmental degradation to economic growth in developing countries by taking into account the environmental Kuznets curve. The focus on environmental degradation is on air pollution in Malaysia. The introduction covers general types of air pollution, air pollution status in Malaysia, National Environmental Policy, Strategies in Environment Management in Malaysia, Implementation of Strategies by Malaysian Department of Environment, air pollution control for Malaysia, Economic Growth in Malaysia, Economic Growth and Air Pollution in Malaysia and Environmental Kuznets curve.

Many countries have clearly demonstrated extraordinary levels of economic performance over the last century, but the question remains as to the costs of such success; whether it is achieved through the sacrifice of environmental quality, and in turn, whether there is actually any contribution by environmental degradation negatively to economic growth and growth ceases eventually. Many recent studies of the Environmental Kuznets Curve (EKC) have tried to answer this question. Earlier papers (Shafik 1992, Panayoutou 1993, Grossman 1995) presented initial evidence that some pollutants followed an EKC pattern. These findings then led to an idea that economic growth is by nature the remedy to environmental problems. However recent works (de Bruyn 2000) have focused on the effect of using different indicators, the use of a wider range of explanatory variables than income alone. Previous literature has focused on the Environmental Kuznets curve (EKC), which hypothesizes and inverted-U shape when pollution indicators are plotted against income per capita. Explanations for this hypothesis generally focus on several primary factors that interact to produce the shape. Among these are changes in the composition of aggregate output as economies evolve from agricultural to industrial to service-based goods and services, technological progress and increases in demand for environmental quality as income grows. EKC is an essentially empirical phenomenon, but most of the EKC literature is econometrically weak. When we do take such statistics into account and use appropriate techniques we find that the EKC does not exist (Perman and Stern 2003). Instead they get a more realistic view of the effect of economic growth and technological changes on environmental quality.

One important critique for the existing empirical EKC studies is that, although in many theoretical models pollution is assumed as both an input and byproduct of production, these studies are based on a single polynomial equation where there is no feedback effect from pollution to economic growth and therefore pollution is viewed only as the outcome of economic growth. The validity of ignoring this feedback effect should depend on that there is no simultaneous relationship between these two variables. However, as we know, in real world, pollutant emission may reduce production either through the restriction of environmental input's supply via environmental degradation or the loss of workdays due to health problem caused by pollution. Thus, the economic growth and the environmental quality are jointly determined, and estimating the relationship only by a single polynomial equation might probably produce biased and inconsistent estimates. From this view, it is therefore more appropriate to use a simultaneous equations model (SEM) for the estimation. There are no empirical studies on Malaysia that estimate the EKC by using simultaneous equation method. Therefore, this study will formulate a simultaneous equations model between per capita Gross Domestic Product and per capita pollutant emission. Based on the theoretical implication, a three-equation model is constructed. The first equation (pollution equation) is a commonly used polynomial equation in EKC empirical literatures. Different from the others, this study adds two extra important variables which are the secondary industry share and government pollution abatement expense into pollution equation to explain the impacts of industrial structure and environmental policy on pollution. The second equation (income equation) manipulates the pollutant emission as an input in an extended Cobb–Douglas production function to control the feedback impact of pollution on income. Since adding government pollution abatement expense into pollution equation may cause another source of simultaneous error into the model, in which pollution abatement expense and the emission level are also jointly determined, therefore, a third equation (abatement equation) is introduced to explain abatement expense. After the simultaneous equations model is constructed, this study is consequently to investigate the difference between single polynomial equation estimators and simultaneous equations estimators. Most of the previous EKC studies focus on using the cross country panel data to estimate the relationship between per capita income and various environmental indicators. However, moving from a cross-country study to an individual country's cross-region study is a new trend for EKC researchers, since the latter one can eliminate the problems associated with cross-country data and allow more being learned from an examination in an individual country. There are no empirical studies on Malaysia that estimate the EKC by using individual country. Therefore, this study will formulate a simultaneous equations model between per capita Gross Domestic Product and per capita pollutant emission based on individual country time series data. Based on all the observation above, it raises an important question: What is the relationship between air pollutants and economic growth in Malaysia whether it is following the concept of EKC or not as previous studies has shown and is there an Environmental Kuznets Curve for air pollutants in Malaysia?

Objectives of the Study

The general objective of the study is to examine the relationship between economic growth and different indicators of air pollution in Malaysia

The specific objectives are firstly, to test whether the EKC actually applies to air pollution in Malaysia. Secondly, to formulate a simultaneous equations model between per capita GDP and per capita pollutant emission. Thirdly, to investigate the difference between single polynomial equation estimators and simultaneous equations estimators. Fourthly, to investigate the contribution of pollution to production and consequently to growth and finally to investigate more variables and use better data for testing the EKC hypothesis in Malaysia (to investigate the influence of pollutant emission on output and the determinants of pollution abatement expense)

REVIEW OF LITERATURE

The environment-growth debate in the empirical literature has centered on the following five questions. First, does the often-hypothesized inverted-U shaped relationship between income and environmental degradation, known as the Environmental Kuznets Curve actually exist, and how robust and general is it? Second, what is the role other factors, such as population growth, income distribution, international trade and time-and-space-dependent (rather than income-dependent) variables? Third, how relevant is a statistical relationship estimated from cross-country or panel data to an individual country's environmental trajectory and to the likely path of present day developing countries and transition economies. Fourth, what are the implications of ecological thresholds and irreversible damages for the inverted-U shaped relationship between environmental degradation and economic growth? Can a static statistical relationship be interpreted in terms of carrying capacity, ecosystem resilience and sustainability? Finally, what is the role of environmental policy both in explaining the shape of the income-environment relationship, and in lowering the environmental price of economic growth and ensuring more sustainable outcomes? (Panayotou, 1998)

Empirical models of environment and growth consist usually of reduced form single-equation specifications relating an environmental impact indicator to a measure of income per capita. Some models use emissions of a particular pollutant (e.g. SO_2, CO_2, or particulates) as dependent variables while others use ambient concentrations of various pollutants as recorded by monitoring stations; yet other studies employ composite indexes of environmental degradation. The common independent variable of most models is income per capita, but some studies use income data converted into purchasing power parity (PPP) while others use incomes at market exchange rates. Different studies control for different variables, such as population density, openness to trade, income distribution, geographical and institutional variables. The functional specification is usually quadratic; log quadratic or cubic in income and environmental degradation. They are estimated econometrically using cross-section or panel data and many test for country and time fixed effects. The ad hoc specifications and reduced form of these models turns them into a "black box" that shrouds the underlying determinants of environmental quality and circumscribes their usefulness in policy formulation. There have been some recent efforts to study the theoretical underpinnings of the environment-income relationship and some modest attempts to decompose the income-environment relationship into its constituent scale, composition and abatement effects (Panayotou, 1998). However, as Stern (1998) has concluded, there has been no explicit empirical testing of the theoretical models and still we do not have a rigorous and systematic decomposition analysis.

A number of critical surveys of the EKC literature have been published. The key critism of Mariano Torras, James K. Boyce (1998) hypothesize that more equitable distributions of power tend, ceteris paribus, to result in better environmental quality. Their regression results generally are consistent with this hypothesis. Literacy and rights appear to be particularly strong predictors of pollution levels in the low-income countries. The estimated effects of per capita income on pollution generally weaken once they account for inequallty effects, but they do not disappear altogether. In those cases where higher per capita income continues to be associated with less pollution, there are at least three possible explanations. First, it is likely that their proxy variables do not fully capture income-related changes in power inequality; better controlling for these might further weaken the pure income effects. Second, individual demand for environmental quality may rise with income and rise more strongly than demand for other goods and services, the production and consumption of which generate pollution such that even with an unchanged distribution of power, there is greater politically effective demand for environmental quality. Finally, as average income in a given country rises, pollution-intensive production may be relocated to lower-income countries. If so, this may reflect power inequalities among countries, as well as within them. One policy implication of their findings is that, in the developing countries, the growth of per capita income can be accompanied by improvements in at least some important dimensions of environmental quality. They agree with Grossman and Krueger (1996) that 'putting brakes on economic growth in the developing world is not an acceptable, or even a wise, response to the pressing environmental concerns of our time'. To this, however, they would add two further policy implications. First, promoting more equitable power distributions in the developing world is a wise response. Their findings indicate that efforts to achieve a more equal distribution of power, for example, via more equitable income distribution, wider literacy, and greater political liberties and civil rights, can positively affect environmental quality. The effects of these variables appear to be particularly strong in low-income countries. From an environmental standpoint, then, the distribution of power is not a peripheral concern. Second, people cannot assume that environmental improvements will continue to accompany further growth of per capita income in those countries which have already attained high average incomes. For countries in the upper-income range, there is evidence that rising average income is associated with renewed deterioration in some dimensions of environmental quality. The extent to which this trade-off can be relaxed through social, political and technological changes remains an open question.

Recent critiques by Kristin Kiesel (2006) stated that there is no single EKC that fits all pollutants for all places at all times. It seems to work best for local air pollutants such as oxides, nitrogen, sulfur dioxide, and particulate matter. Income growth without institutional matters is not enough. Whether improvements materialize depends on government policies, social institutions and the completeness and functioning of markets need to look for structural explanation of the EKC. It is likely that higher levels of development lead to structural change towards information-intensive industries and services increased environmental awareness enforcement of environmental regulations, better technology higher environmental expenditures, and hence result in leveling off and gradual decline of environmental degradation. Different industries have different pollution intensities and typically output mix changes over course of economic development (e.g. from agrarian to industrial to service economy). Differences in input use as developing countries use less input all together but increase inputs with economic growth which in turn increases pollution. This effect partly counterbalanced by changes in production efficiency and cleaner technology as it requires using less of the inputs and applies cleaner technologies (but R&D is needed to increase production efficiency and cleaner technology, such that technological change is more likely to happen after substantial growth). All three factors might explain inverse U shape of EKC in that richer countries can afford better technologies and will shift to less polluting industries due increased concern about pollution; very poor countries pollute less due to limited use of input despite less efficient technologies but what happens to outdated technologies and products in developed countries and how does that contribute to the EKC?

THEORETICAL FRAMEWORK

This study has gathered the external information from Department of Environment (DOE) in Malaysia, Department of Statistics in Malaysia, University library, British Council, National library and Memorial library. Besides, the sources like books, newspapers, journals and internet that were relevant to the research topic were used. All the sources have been referred throughout the findings and analysis of the research. To study the relationship between air pollution and economic growth, the study estimates several equations that relate the level of pollution in a location to a flexible function of the current and GDP per capita in the country and to other covariates. Air pollution indicators were assessed on a number of measures: Carbon Monoxide (CO), Sulphur Dioxide (SO_2), Nitrogen Dioxide (NO_2), Ozone (O_3) and Suspended Particulate Matter (SPM). The income levels GDP (Gross Domestic Product) per capita were measured from year 1996 to 2006 quarterly.

Following Grossman and Krueger's (1991) path-breaking study, extensive literature had developed reporting EKC estimates and discussing their implication. Earlier papers by Selden and Song (1994) and Grossman and Krueger (1995) presented initial evidence that some pollutants followed an EKC pattern. These findings then led to some naive idea that economic growth is, by nature, the remedy to environmental problems. However, recent works have focused on the effect of using different indicators, the use of a wider range of explanatory variables than income alone, and the estimation of different models (de Bruyn, 2000). Within these works, the EKC results are not generally reproduced. One important critique for the empirical studies of the EKC is that they are based on a reduced form model where there is no feedback effect from the environment to economic growth and therefore environmental quality is invariably viewed as the outcome of economic growth (Stern, 1998; de Bruyn, 2000). In all of the EKC empirical literature, the effect of economic growth on environmental quality is estimated directly. However, it is well known that, in addition to the effect of economic growth on environmental quality, environmental degradation may directly impact upon economic growth through a restriction or reduction in production (Barbier, 1994; Pearce and Warford, 1993) and adverse effects upon production factors (de Bruyn, 2000), or indirectly through higher emission reduction costs. It is therefore inappropriate to estimate a single equation model of unidirectional causality from economy to environment. As Stern (1998) concluded, "estimating single equation relationships by ordinary least squares where simultaneity exists produces biased and inconsistent estimates." Hence, "a simultaneous-equation model may be more appropriate for understanding the environment-income relationship". However, there is not any empirical study that estimates the simultaneous relationship between economic growth and environmental quality due to the difficulty in model specification and demanding data requirements (de Bruyn, 2000). This study will formulate a simultaneity model between income and the environment and then to estimate the EKC. In this study, it will first develop a conceptual model of the simultaneous relationship between income and pollution and then formulate two equations for empirical research. One is the income equation and the other one is the pollution equation. Even though this study is not able to estimate the full structural model because its estimation requires data over a large number of years, not only for pollution and income but also for all intermediate variables, such as policy, technological progress, and structural changes, the researcher take a more flexible approach by estimating a simultaneous two-equation model. The integration of theoretical and empirical models provides us with an enhanced understanding of the relationship between economic growth and the environment.

A Hausman test for income endogeneity is given to determine the econometric justification of the model specification. When Cole et al. (1997) and Holtz-Eakin and Selden (1995) test the income exogeneity, they found no evidence of simultaneity for their data. In this study, however, it rejects the income exogeneity hypothesis for two pollutants and thus, goes on to estimate pollution and income equations simultaneously. The other purpose of this study is to investigate the contribution of pollution to production and, consequently, to growth. In recently developed endogenous growth models, human capital accumulation, fertility choice, research and development (R&D), and pollution, etc., have been proposed as a means of explaining output growth. Among these, while pollution has been considered important theoretically as the role of inputs, the adverse impacts on labors, man-made inputs and production and no studies have yet examined the effects of pollution on production empirically. This study could realize here the effects of pollution on production in Malaysia based on the estimated pollution and income equations. Another purpose is to investigate more variables and use better data for testing the EKC hypothesis in Malaysia. Moving from cross-country to single-country studies is a new line for EKC researches. Cross-country studies suggest that the EKC may only be a valid description of the environment-income relationship for a subset of all possible indicators. In fact, as Stern et al. (1994) have argued, "more could be learnt from examining the experiences of individual countries at varying levels of development as they develop over time." These considerations have given rise to a new line of research based on single-country analysis. This econometric approach achieves some surprising results that cast serious doubts on the reliability of the indications emerging from cross-country studies. Moreover, de Bruyn et al. (1998) reach similar conclusions following other individual countries over time. They investigate emissions of several air pollutants (sulfur dioxide, carbon dioxide and nitrous oxides) in four OECD countries (Netherlands, West Germany, UK and USA) between 1960 and 1993 and find them to be positively correlated with growth in almost every case. However, these conclusions are questioned by Carson et al. (1997) who find the opposite result in a single-country study on the Unites States. Using data collected by the Environmental Protection Agency from the 50 US states, Carson et al. (1997) find that per capita emissions of air toxics decrease as per capita income increases.

In conclusion, all current single-country studies seem to suggest that the EKC need not hold for individual countries over time. However, different studies reach conflicting results as to the effects of growth on the environment. Therefore, further research is needed to understand the evolution of environmental degradation relative to income in a single country over time (Simone Borghesi, 1999). In fact, cross-country studies implicitly assume that all countries will follow the same pattern in order to infer the environment-income relationship of a single country over time. As mentioned above, this assumption does not seem to be supported by empirical evidence. Similarly, in order to infer the environmental degradation of the whole country over time, cross-regional studies implicitly assume that all regions in a given nation will follow the same pattern. For some countries, however, regional differences can be very significant. Thus, the environment-income relationship may not only differ across nations, but also across regions of the same country. Hence, although current single-country studies tend to go in the right direction, a time-series approach seems more appropriate than a cross-regional one to examine individual countries over time and this is the line of research that single-country analyses should develop in the future (Simone Borghesi, 1999). Here, it study more air pollutants and include additional important pollution control policy measures as the explanatory variables.

Model Specification for the Study

This study examines the interactions between air quality and per capita income using ambient concentrations air quality data in Malaysia. Since no one can escape the impacts of poor air quality and the data is more complete, air quality is examined here. There are many driving forces behind the two-way relationship between Y and P such as income influences the environmental quality directly because pollution is its by-product. In addition, income can influence the environmental quality indirectly too. Income grows is accompanied by increasing demands for improvements in environmental quality and thus, through some driving forces such as technological progress, structural changes in consumption, public and private control measures, production, international trade, and institutions, pollution reduced. Other than that, the role of pollution on production is also multiple. Firstly, pollution may act as a negative externality, directly reducing output and productivity of man-made capital and labor (Lopez, 1994; de Bruyn, 2000). Examples are the loss of days worked due to health problems, the corrosion of industrial equipment due to polluted air or water, and product voided because of being polluted. If pollution reduces (increases), output will increase (decrease). Secondly, since permitting greater levels of emission may increase the availability of more human and man-made capital for production, when firms abate pollution emissions, their production costs are raised and outputs are reduced. In addition to the driving forces mentioned above, the income-environment relationship would also be influenced by some exogenous variables such as traditional production factors, policies, population density and site-specific variables. This study followings Hung and Shaw's (2004). The earliest EKCs were simple quadratic functions of the levels of income. However, economic activity inevitably implies the use of resources and by the laws of thermodynamics, use of resources inevitably implies the production of waste.

This study specifies the simultaneity model of income and the environment as follows to estimate the relationship between pollution and GDP per capita in Malaysia. This study combine a single polynomial equation of income affecting pollution with an extended Cobb–Douglas production function and an equation explaining the determinants of environmental policy (government pollution abatement expense), under the consideration of feedback effect of pollution on production and the simultaneous relationship between pollution and abatement expense. Then, the simultaneous equations model can be given as Equations (1), (2), and (3). This study employed a t test to check the statistical significance of the cubic terms of ln (per capita GDP) in all the pollutants and found that all of them are not significantly different from zero even at 10% level. Therefore, this study omit the cubic terms in Equation (1).

$$\ln P_t = \alpha_0 + \alpha_1 \ln Y_t + \alpha_2 (\ln Y_t)^2 + \alpha_3 \ln abate_t + \alpha_4 \ln ind_t + \alpha_5 \ln PD_t + e_t \quad (1)$$

$$\ln Y_t = \beta_0 + \beta_1 \ln P_t + \beta_2 \ln L_t + \beta_3 \ln G_t + \beta_4 \ln FDI_t + \beta_5 \ln K_t + €_t \quad (2)$$

$$\ln abate_t = \lambda_0 + \lambda_1 \ln K_t + \lambda_2 \ln ind_t + \lambda_3 \ln P_t + v_t \quad (3)$$

Equation (1) represents the pollution equation, where

P_t denotes air pollution for year t;

Y_t denotes GDP per capita for year t;

Here income (Y_t) plays as a surrogate variable representing the aggregate effects of those direct and indirect driving forces on pollution. If the coefficients of the lnY term and its squared term are positive and negative, respectively, then the EKC hypothesis holds.

Equation (3) is applied into the model to control the simultaneous relationship between the per capita pollutant emission and the per capita pollution abatement expense. In addition to the income terms, the pollution equation is often studied by including other variables such as population density and site-specific variables. The variables of the secondary industry share and government pollution abatement expense into pollution equation to explain the impacts of industrial structure and environmental policy on pollution. The inclusion of other variables aims to improve the fit of the estimations and to provide additional explanations for the patterns of pollutants along economic development. Many recent EKC studies have focused on examining possible determinants of the EKC relationship, like trade, political freedom, policy variables, etc., to investigate the impact of various exogenous variables on the EKC relationship (de Bruyn, 2000). Taking into consideration of data availability, this study includes population density as exogenous variable, which might be closely related to pollution in Malaysia. Equation (2) is actually an extended Cobb-Douglas production function. In this specification, output is a function of air pollution (P_t), raw labor (L_t), local government expenditure (G_t), foreign direct investment (FDI_t) and fixed capital investment (K_t). It is expected that all but the pollution variable should contribute positively to output growth. Here too, pollution (P_t) plays as a surrogate variable representing the aggregate effects of those direct and indirect driving forces on production. This study expects that the aggregate effects of air pollution on production might not be significant. Relatively to other kind of environmental problems, such as deforestation, desertification and land erosion, air pollution dissipates in a more rapid way. Since people could also take averting behaviors, the negative impacts of air pollution on production could therefore not be serious enough. Since adding government pollution abatement expense into pollution equation may cause another source of simultaneous error into the model, in which pollution abatement expense and the emission level are also jointly determined, therefore, a third equation (abatement equation) is introduced to explain abatement expense.

Estimation Procedures

This study estimates the simultaneity model of income and environment. Ambient concentrations of air pollutants are functions of income, population density and control variable. This study regress income on four commonly used production input variables (labor, government expenditure, foreign direct investment and fixed capital investment) as well as ambient air quality. For the purpose of this study, a Hausman test is employed first to test the exogeneity of income in the pollution equations. In the estimated pollution equations, the test shows that there does not exist significant feedback effects between all the indicators of pollution and income. Following the theoretical implication, Table 2 lists the expected signs of all the explanatory variables in Equations (1), (2), and (3). The sign of the government pollution abatement expense in Equation (1), controlling the impact of environmental policy on pollution6, is expected to be negative because the more the investments are placed in pollution abatement, the less emissions are expected to be emitted. Meanwhile, this study expects that the secondary industry share in both Equations (1) and (3) has a positive sign, since the heavier the weight of the secondary industry is, the more pollution is likely emitted, therefore, the more abatement expenses are required. Another explanatory variable in Equation (1), population density, is expected to enter with either a positive sign or a negative sign. Due to the fact that emission will be generated more with population growth, it follows a positive relationship between population density and pollutant emission. However, as Selden and Song (1994) stated that insofar as sparsely populated provinces are likely to be less concerned about reducing per capita emissions, at every level of income, than more densely populated ones. Therefore, a negative sign is also permitted. The existing theoretical frameworks help this study to construct Equation (2) as an income equation. In this extended Cobb–Douglas production function, output is a function of physical capital, labor, and pollutant emission. Both signs of physical capital and labor are expected to be positive. In contrast, pollutant emission is expected to negatively contribute to production due to the reasons that has been mentioned in the previous section. Concerning the role of pollutant emission, physical capital and the secondary industry share being played in Equation (3), all are expected to be positively related to pollution abatement expense.

CONCLUSIONS

This study attempts to measure the actual shape of Environmental Kuznets curve (EKC) in response to modern environment regulation in Malaysia. To represent the change in pollution levels in a country over time as economic development proceeds, the EKC relationship has usually been used as a theoretical model. Although this relationship for air pollution is almost impossible to test when the data for air quality at the early stages of industrialization does not exist, however there are some historical accounts of air quality prior to the industrial revolution that can be used. In theory, the environment EKC relationship should also be applicable for Malaysia at different stages of economic development and air quality. To explore further the relationship between economic growth and air pollution in Malaysia, data was collected to prepare basic EKCs for selected air pollutants. The graphs were designed to reveal current trends in Malaysia. GDP per capita and annual ambient concentrations air quality data was collected to create the EKCs. As a conclusion, this study considers four significance of the study. Firstly, at certain stage of economic growth and development, which key air pollution can be effectively controlled in Malaysia. Secondly, in response to modern environment regulation, has the shape of the EKC curve been changing in Malaysia. Thirdly, the factors that may be influencing the EKC relationship in Malaysia and finally has there have been a weakening of the relationship between economic growth and air pollution in Malaysia.

This study contributes to the available literature Hung and Shaw's (2004) in using EKC by modifying this model and extends it to include variables such as foreign direct investment, fixed capital investment, the industry secondary share and government pollution abatement expense. This study attempts to close the gap from what had happened in the high-income countries such as Japan, the U.K. and the U.S. during the last century. These countries by contrast all followed the pattern of "pollute first and clean up later. It thus needs to be asked whether a latecomer such as Malaysia could have been capable of avoiding this pattern by adopting the policy that economic growth could not continue without consideration being given to its impact upon on the environment from the earliest days of development. This study would not expect to see any deterioration in the environmental quality, or even an improvement in it along with the rapid economic development, if such policies and regulations were to be completely enforced. That is, this study would not be able to find an inverted U-shaped relationship between income and environmental quality, i.e. the famous Environmental Kuznets Curve (EKC), as has been observed for many different kinds of environmental quality indices in the high-income countries. Another contribution of this study is there is no empirical studies on Malaysia that examine the relationship between economic growth and different indicators of air pollution in Malaysia after 1990s to the year of 2006. It has been examined once by Vincent (1997) from the late 70s to the early 90s. Next, there are no empirical studies on Malaysia that estimate the EKC by using simultaneous equation method. Therefore, this study will formulate a simultaneous equations model between per capita Gross Domestic Product and per capita pollutant emission. Finally, there are no empirical studies on Malaysia that estimate the EKC by using individual country. Therefore, this study will formulate a simultaneous equations model between per capita Gross Domestic Product and per capita pollutant emission based on individual country time series data.

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