A METHOD FOR EVALUATING A REGION’S ECONOMIC AND ENVIRONMENTAL SITUATION

The case of East Asian countries

D. Giannias, P. Liargovas and G. Manolas

Abstract This paper classifies East Asian countries on an amenity–productivity map based on environmental quality and income differentials. This classification is useful because it provides information about the relative attractiveness to consumers and producers of the total bundle of environmental and other attributes indigenous to each region. It also assists policymakers to formulate the most suitable regional and environmental policies. Our findings suggest that the notion of sustainable development is best suited for low productivity countries such as Indonesia, the Philippines, Thailand, and Malaysia.

Keywords Sustainable development, environment, productivity, amenity, East Asia.

1. INTRODUCTION

Policy-makers are very often concerned with the persistence of large disparities among different regions or countries in terms of economic and social performance. Within a framework in which regions and factors are identical and all economic agents are free to move, neoclassical analysis supports the view that the output (and income) of different regions should tend to converge over time towards a steady state. This view, however, has been challenged by a number of new growth models. These new growth models assume non-convexity in production or externality arising from the accumulation of human capital. In these models, regional outputs per head can actually diverge.

We also challenge the neoclassical view by offering an alternative explanation; in the presence of free mobility, consumer income differentials can persist because some factors are inherently immobile; for example, the environmental and climatic characteristics that are unique to a region. It is
possible that several regions share the same site-specific characteristics, but it is unlikely that their distribution will be exactly the same.

Economic agents would be willing to pay or accept a different level of incomes depending on the value they place on these characteristics. For example, a furniture company may find that its location in a region with many forests and woods reduces its production costs. This implies that this particular firm can offer relatively higher incomes to its employees and still remain competitive in relation to other furniture companies located in lower-income regions since the characteristics of the region are offering it a cost advantage. Since office space and other facilities in the area are limited, the furniture companies attracted by the rich-in-wood region will increase the demand for both labor and office space. These increases in the prices of labor and office space will continue until, in equilibrium, they have completely offset the cost advantage of the forestry region. Incomes and rents will vary across regions according to the value companies place on the region-specific attributes in each region and their ability to substitute between factors of production.

Similarly, for their own reasons consumers put their own value on a region. Consumers consider the overall environmental quality of a region when they make a decision concerning the place they will live in. They are assumed to consider the distribution of the characteristics of the natural environment. The region, for example, with many forests that offered a cost advantage to some firms producing furniture may be attractive to consumers because of high air-quality. Consequently, as more consumers move into the area, the supply of labor increases as well as the demand for housing. Thus rents increase and wages fall until individuals are in equilibrium no longer willing to accept moving to a high air-quality region as compensation for lower wages and higher rents.

The final income differentials between a geographical area with many forests and one without depends upon the relative size of the demand and supply responses to site characteristics. If incomes are observed to be higher in the forestry area than in the other, then the firm’s response dominates the rent determination process. If incomes are relatively lower in the good transport system area, then the consumers’ response dominates the process. In both cases rents will be higher because both households and firms value positively the existence of forests. Rents would be lower than in otherwise comparable geographical areas if forests were not important to both parties. Consequently, by observing relative consumer incomes and rents, or by observing other variables having a monotonic relationship with them, it is possible to identify whether a region’s bundle of environmental characteristics has a greater net effect on company location decisions or consumer location decisions.

The purpose of this paper is to identify East Asian countries according to the extent they are dominated by supply and demand responses to their net
bundle of country-specific attributes. The countries are then classified into four groups based on the relative values of a country’s per capita income and environmental quality. These are then identified as high amenity (low consumer income, high environmental quality), low amenity (high consumer income, low environmental quality), high productivity (high consumer income, high environmental quality), and low productivity (low consumer income, low environmental quality). The usefulness of this classification is twofold. First, it provides information about the relative attractiveness to consumers and companies of the total bundle of environmental and other attributes indigenous to selected East Asian countries. Second, it assists policy-makers to formulate the best suited regional and environmental policies. High amenity countries or regions, for example, require regional policy measures so as to increase their income. Similarly, low amenity countries or regions require environmental policy measures so as to increase their quality of life. Finally, in low productivity and low amenity areas both policies, regional and environmental, are important for increasing the consumer’s income and his/her environmental quality of life.

We have chosen East Asian countries because the experiences that come from this area have progressed our understanding of the links between economic development and the environment. Over the past quarter of a century, economic growth per capita in East Asian countries averaged 5 per cent a year. In Indonesia, Malaysia, and Thailand, the percentage of the population living below the poverty line is estimated to have declined by some 50–70 per cent. Before them, Hong Kong, Japan, Korea, Singapore, and Taiwan made dramatic economic gains. At the same time, environmental losses in East Asia have surpassed in many respects those of other regions. For example, nine of the world’s fifteen cities with highest levels of particulate air pollution are in this region. About 20 per cent of land covered by vegetation suffers from soil degradation owing to waterlogging, erosion, and overgrazing at levels above world averages. Fifty to 75 per cent of coastlines and marine protected areas are classified as areas with highly threatened biodiversity, and the region has witnessed some of the highest deforestation rates in the world.

Section 2 of the paper develops a theoretical model to determine the importance of amenity and productivity differences as sources of income differentials across countries. Section 3 applies this model to the case of East Asian countries, while section 4 offers some conclusions and policy implications.

2. THEORETICAL FRAMEWORK FOR EVALUATING A REGION’S ECONOMIC AND ENVIRONMENTAL SITUATION

In this section a theoretical framework is presented for the evaluation of the economic and environmental situation in a region or country. It is
assumed that consumers have identical tastes and skills and are completely mobile, migration is costless, capital is completely mobile, production technologies are identical across companies and exhibit constant returns to scale, and, finally, companies and consumers have chosen locations such that they could not be made better off by relocating.

In our analysis, regions or countries are fully described by a bundle of environmental and other attributes. These specify the environmental quality index of a country or region, $EQ$, which includes all aspects of natural and non-natural environment of a consumer’s life. $EQ$ affects the utility of consumers, $U(\cdot)$, and the cost of production for firms, $C(\cdot)$. Individuals in these regions are assumed to consume and produce the numeraire good, $X$, which is a composite good with a price that is equal to one. Each consumer supplies one unit of labor and receives his income, $I$, in return. His income is assumed to be a function of the environmental quality of the region, $I = I(EQ)$, and is spent on housing and the numeraire good. The rental price of a house is a function of the vector of housing characteristics, $h$, and the environmental quality of the region, $EQ$; that is, the rental price of a house is specified by the following function: $P = P(h, EQ)$. It is assumed that $P(h, EQ) = R(EQ) h'$, where $h'$ is the transpose of $h$, and $R(EQ)$ is the vector of implicit prices for each housing characteristic. An equilibrium must be characterized by equal utility for identical consumers and equal unit costs for firms across all regions.

A utility-maximizing consumer solves the following optimization problem:

$$\max U(h, X, EQ)$$

with respect to $h, X, EQ$ subject to $I(EQ) = R(EQ) h' + X$

where $I(\cdot)$ and $P(\cdot)$ are the equilibrium income and rental hedonic equations, respectively.

Let $EQ^*, h^*,$ and $X^*$ be the solutions to the above utility maximization problem specifying, respectively, the region he will be in, $EQ^*$, the kind of house he will live in, $h^*$, and how much of the numeraire good he will be able to consume, $X^*$. As a result of it, we have that the income of the consumer will be $I^* = I(EQ^*)$, and the rent he will pay for his house is: $P^* = P(h^*, EQ^*) = R^* h'^*$, where $R^* = R(EQ^*)$. Equivalently, the problem can be stated in terms of an indirect utility function $V(\cdot)$ where,

$$V(I^*, EQ^*, R^*) = \max U(h, X, EQ^*)$$

with respect to $h, X$ subject to $I^* = R^* h'^* + X$

Equilibrium for consumers requires that utility is the same at all regions; that is, $V(I, EQ, R) = v$, where $v$ is a constant. This equilibrium condition implies that individuals in regions with better environmental quality pay for it through reductions in real income in the form of higher rent and lower wage income.
A cost-minimizing firm solves the following problem:

$$\min I(EQ) I(L) + rK + R(EQ) h'$$

with respect to $L, K, h, EQ$ subject to $X = f(K, L, h, EQ)$

where $K$ is capital, $L$ is labor, $I(\cdot)$, and $P(\cdot)$ are the equilibrium income and rental hedonic equations, respectively, $r$ is the unit price of capital, and $f(\cdot)$ is a constant returns to scale production in $K$ and $L$.

Let $EQ^*, h^*, K^*$, and $L^*$ be the solutions to the above cost minimization problem specifying, respectively, the region the production activity takes place, $EQ^*$, the kind of building or office the company will use, $h^*$, and how much of capital and labor will employee ($K^*, L^*$). As a result of it we have that the income that the company will pay to the consumer will be $I^* = I(EQ^*)$, and the rent he will pay for the building facilities it uses is $P^* = P(h^*, EQ^*) = R^* h^*$, where $R^* = R(EQ^*)$. Equivalently, the problem can be stated in terms of a unit cost function $C(\cdot)$ where,

$$C(I^*, EQ^*, R^*) = \min I^* L + rK + R^* h'$$

with respect to $L, K, h$ subject to $X = f(K^*, L, h, EQ^*)$

Equilibrium for producers requires that unit cost is the same at all countries; that is, $C(I, EQ, R) = c$. If the overall environmental quality of a region provides a net productivity advantage to firms, they will pay for it in terms of higher incomes and rents. Wages and rents in each region are finally determined by the interaction of the location decisions of households and firms.

The model described above is illustrated in Figure 1. The downward sloping curve in Figure 1, labeled $V(I, EQ; R)$, shows combinations of $I$ and $EQ$ for which utility is equal to $v$. The slope of these curves is the tradeoff that households are willing to make between wage income and environmental quality for any given level of implicit prices for housing characteristics ($R$) and the given utility level $v$. Along each curve, the implicit prices of housing characteristics are fixed and the curves shift up (down) as the implicit prices of the housing characteristics increase (decrease). The implicit prices of housing characteristics in the region labeled 2 is greater than those in the region labeled 1, since individuals enjoying a higher environmental quality at every level of income must have in equilibrium their utility equal to $v$, so that there is no incentive for moving to other regions.

Combinations of $EQ$ and $I$ for which the unit costs of firms are equal are depicted in Figure 2. The value of the environmental quality of the region to firms is fixed along each iso-cost curve, and the curves shift up (down) as the environmental quality of a region increases (decreases) the productivity of firms and the implicit prices, $R$, of the real estate market. According to Figure 2, the implicit prices in region 2 are greater than those of region 1, since firms facing a higher level of environmental quality and
having as a result a higher productivity at every level of wage income must have in equilibrium their unit cost equal to $c$, so that there is no incentive for moving to other regions.

Each region is characterized by an environmental quality index and a vector of implicit rental prices that are associated with a specific pair of isocost and iso-utility curves as in Figures 1 and 2. The intersection of any two curves for each region at the level of its environmental quality then determines the relative income and the implicit prices of the real estate market in equilibrium. In Figure 3, in region 1, where environmental quality equals $EQ_1$, the equilibrium income will be $I_1$ and the equilibrium implicit rental prices $R_1$. Using region 1 as a reference point, which could be thought as the average region, we can see in the following how inter-regional differences in environmental quality will be reflected in differences in incomes and implicit rental prices.

Consider a region 2 that differs from 1 only in that the environmental quality of region 2 is valued more by consumers than the environmental quality of region 1. This implies that, *ceteris paribus*, rents in region 2 will be relatively higher than rents in region 1. In Figure 3, this is illustrated by $V(R_2)$ lying above $V(R_1)$. Assuming there is no difference in environmental quality between the two regions from the firms’ point of view, we can see that equilibrium requires that incomes in region 2 be lower relative to region 1 and that $C(R_2)$ lies above $C(R_1)$ as shown in Figure 3. The higher rents and lower incomes reflect the amount consumers are willing to pay to locate in region 2 rather than 1 and, therefore, the value of $EQ_2$ relative to the average region. Moreover, since from the firms’ point of view there is no difference in environmental quality between the two regions, the effects of higher rents and lower incomes on costs offset each other so that unit costs remain in equilibrium equal to $c$.

Consider another region, region 3, that differs from 1 only in that the environmental quality $EQ_3$ provides a greater productivity advantage to firms. This implies that, *ceteris paribus*, rents in region 3 will be relatively higher than rents in region 1. This relationship is illustrated in Figure 4, where region 3 is represented by $C(R_3)$ which is to the left of $C(R_1)$. If no location differences exist from a consumer’s point of view, we can see that equilibrium requires that incomes in region 3 are higher relative to region 1 and that $V(R_3)$ lies above $V(R_1)$ as shown in Figure 4. The higher rents and incomes reflect the amount firms are willing to pay to locate in region 3 rather than 1, and, therefore, the productivity value of $EQ_3$ relative to the average region. Moreover, since from the consumer’s point of view there is no difference in environmental quality between regions 1 and 3, the effects of higher rents and incomes on the maximum utility of a consumer offset each other so that the maximum utility that a consumer enjoys in equilibrium remains equal to $v$.

Putting the above cases of Figures 3 and 4 on the same graph (Figure 5),
it is seen that: (i) when environmental quality is valued more by consumers, ceteris paribus, \( C(R_2) \) and \( V(R_2) \) have both been moved up and \( C(R_2) \) has moved up relatively more, and (ii) when environmental quality is valued more by firms, ceteris paribus, \( C(R_3) \) and \( V(R_3) \) have both moved up and \( V(R_3) \) has moved up relatively more.
Within this framework in which regions differ only in their environmental quality, we can determine whether environmental quality and income differences primarily reflect consumers’ or firms’ dominated responses. In the first case we would see a negative relationship between environmental quality and incomes. In the second case, the relationship would be positive.

Within the same framework, we can also classify individual regions or countries on the basis of whether their incomes and environmental quality differ from the average. These classifications are summarized in Table 1 and Figure 6. Environmental quality is higher than the average in the high amenity and high productivity countries and lower than the average in the low amenity and low productivity countries. On the other hand, incomes are relatively higher in high productivity countries as well as in low amenity countries.

Each region is characterized by an environmental quality index, $EQ$, whose effect on household utility and production costs differs from region to region. The problem of classifying regions by the relative magnitude of
these two effects becomes one of identifying the location and income differences in equilibrium relative to the shifts in each curve. This can be done by identifying the combinations of \( EQ \) and \( I \) in equilibrium that are associated with equal shifts of both curves and determining how incomes and environmental quality change relative to these shifts. The \((EQ, I)\) equilibrium combinations associated with equal shifts of both curves would coincide with the \( EQ_1 O \) and \( I_1 O' \) lines in Figures 5, 6, and 7, where \( EQ_1 \) is the mean environmental quality and \( I_1 \) is the mean income.

For any region with above-average incomes and environmental quality, the shift of the \( C(R) \) curve must be less than the shift of the \( V(R) \) curve. The less the direct effect of environmental quality on utility, the greater the increase in consumer income needed to offset the increase in rents and, consequently, the greater the shift of the \( V(R) \) curve needed to keep the maximum utility level unchanged and equal to \( v \) in equilibrium. Therefore, any region with environmental quality and income combinations in

---

### Table 1

<table>
<thead>
<tr>
<th>Classification of regions</th>
<th>Direction of differentials</th>
<th>Shift</th>
</tr>
</thead>
<tbody>
<tr>
<td>High amenity</td>
<td>Low &lt; EQ, High &gt; Shift</td>
<td>Both curves up and ( C(R) ) relatively more</td>
</tr>
<tr>
<td>Low amenity</td>
<td>High &gt; EQ, Low &lt; Shift</td>
<td>Both curves down and ( C(R) ) relatively more</td>
</tr>
<tr>
<td>High productivity</td>
<td>High &gt; EQ, High &lt; Shift</td>
<td>Both curves up and ( V(R) ) relatively more</td>
</tr>
<tr>
<td>Low productivity</td>
<td>Low &gt; EQ, Low &lt; Shift</td>
<td>Both curves down and ( V(R) ) relatively more</td>
</tr>
</tbody>
</table>

---

![Figure 6](image-url)
quadrant A in Figure 6 is classified as a ‘high productivity’ region, because the primary reason that this region’s incomes, environmental quality, and rents differ from those of the average region is the below-average cost effects of environmental quality. This below-average cost effect is reflected in the ability of producers in these regions to pay higher average incomes and rents for having at their disposal a greater than the average environmental quality, which reduces their cost.

Similarly, regions with below-average incomes and environmental quality (quadrant C in Figure 6) are classified as ‘low productivity’ regions, because the primary reason that this region’s incomes, environmental quality, and rents differ from those of the average region is the above-average cost effects of environmental quality.

High and low amenity regions are reflected by quadrants B and D, respectively. These regions are associated with increases (decreases) in rents and decreases (increases) in incomes reflecting the consumers’ willingness to pay relatively more (less) for the effects of the regional characteristics embodied in the region’s environmental quality. Quadrant B then identifies ‘high amenity’ regions where the environmental quality is greater than the average. Similarly regions in quadrant D, are characterized as ‘low amenity’ regions.

3. APPLICATION OF THE AMENITY–PRODUCTIVITY CLASSIFICATION IN THE CASE OF EAST ASIAN COUNTRIES

As an application of the above theory, we specify the following index of environmental quality of a region:

$$RI = \frac{\sum_{i=1}^{N} (w_i a_{ij})}{\sum_{i=1}^{N} w_i}$$

for $j = 1, 2, 3, \ldots, m$, where $a_{ij}$ is the $i$th environmental characteristic of region $j$, $w_i$ is the weight for the characteristic $i$, $N$ is the number of environmental and other characteristics considered, and $m$ is the number of regions being examined. The weights $w_i$ can be all equal to $1/N$ or be assigned atheoretically using principal component or survey results. However, in all cases the weights should be the same across regions; that is, they should not be indexed by $j$.

Similar indices reflecting most of the major environmental concerns have been used in the past by Hope and Parker (1990, 1995), Hope et al. (1991, 1992), Giannias (1996, 1997, 1998), Roback (1982), and Blomquist et al. (1988). The focus of all these studies – unlike our study – is on West European or North American countries.
To compute the environmental quality, $EQ$, for each country, the following variables of the natural environment of a country were available and considered:

- $Y_{1,j}$: Annual internal renewable water resources per capita;
- $Y_{2,j}$: Wilderness area as a percentage of total land area;
- $Y_{3,j}$: Percentage of national land area protected for wildlife and habitat;
- $Y_{4,j}$: Number of threatened mammals per 10,000 km$^2$;
- $Y_{5,j}$: Number of threatened birds per 10,000 km$^2$;
- $Y_{6,j}$: Number of threatened reptiles per 10,000 km$^2$;
- $Y_{7,j}$: Number of threatened amphibians per 10,000 km$^2$;
- $Y_{8,j}$: Endemic flora as a percentage of total;
- $Y_{9,j}$: Number of botanical gardens;
- $Y_{10,j}$: Forest area as a percentage of land area;
- $Y_{11,j}$: Per capita carbon dioxide emissions.

An environmental quality index that takes into consideration all aspects of the natural environment of a consumer’s life could be taken to be equal to the mean of these variables. However, a mean cannot be computed directly, because of differences in the units of measurement of the above variables. Therefore, these variables need to be scaled before a mean is computed. To be more specific, the above variables for each country are scaled from 0 to 100 using the following transformations:

\[
y^*_ij = 100 \left( \frac{Y_{ij} - Y_{ijmin}}{Y_{ijmax} - Y_{ijmin}} \right)
\]

where $y^*_ij$ is the transformed variable, $Y_{ijmin}$ is the minimum value of $Y_{ij}$ and $Y_{ijmax}$ is the maximum value, for $i = 1, 2, 3, 8, 9, 10$; that is, for all variables having a positive relationship with $EQ$, and all $j$, and

\[
y^*_ij = 100 - \left\{ 100 \left( \frac{Y_{ij} - Y_{ijmin}}{Y_{ijmax} - Y_{ijmin}} \right) \right\}
\]

where $y^*_ij$ is the transformed variable, $Y_{ijmin}$ is the minimum value of $Y_{ij}$ in the sample of countries and $Y_{ijmax}$ is the maximum value, $i = 4, 5, 6, 7, 11$; that is, for all variables having a negative relationship with $EQ$, and all $j$.

Finally, to compute the environmental quality $EQ$ for each country we have used data from the World Resources (1992) and the Human Development Report (1993). The weights of the scaled variables $y^*_ij$ were based on a 1996 experts’ opinion survey. In this opinion survey we asked 120 environmental experts to value on a 0–100 scale the importance of each one of the above eleven variables for the environmental quality of a region. The average weights for each variable were used to compute environmental quality. The weights are given in Table 2.

The per capita income, $I$, of each country is also scaled from 0 to 100 using the following transformation:

\[
I^*_j = 100 \left( \frac{I_j - I_{min}}{I_{max} - I_{min}} \right)
\]
where $I_j^*$ is the transformed index, $I_{\text{min}}$ is the minimum index value in the sample of countries and $I_{\text{max}}$ is the maximum value, and $j = 1, 2, 3, \ldots, m$.

The environmental quality and per capita income combinations, $(EQ, I^*)$, for Japan, Korea, Singapore, the Philippines, Indonesia, Malaysia, Thailand, and China are given in Table 3. Table 3 and the results of our theoretical analysis imply the positioning mapping of Figure 8, where $m(EQ)$ and $m(I^*)$ are the means of $EQ$ and $I^*$, respectively. This identifies four groups of countries; namely, the low productivity ones: Indonesia, the Philippines, Thailand, and Malaysia; the high amenity ones: China and Korea; the high productivity country: Japan; and the low amenity country: Singapore.

Our findings suggest that environmental and regional policies are equally important for the sustainable development in a region or country. The notion of sustainable development is best suited in the low productivity group of countries. As mentioned before, this group includes Indonesia, the
Philippines, Thailand, and Malaysia. Sustainable development brings together amenity and productivity into the same conceptual framework from which mutually beneficial objectives may be achieved. In the low amenity group, which includes Singapore only, emphasis should be given to environmental measures, since its high income and low environmental quality characterize this group. Finally, in the cases of China and Korea, emphasis should be given to regional policy, since low income and high environmental quality characterize these countries. Japan is the only country that has achieved both high income and high environmental quality.

4. CONCLUDING REMARKS

In this paper we offered a method for evaluating the economic and environmental situation in East Asian countries. A theoretical framework was used to position East Asian countries on an amenity–productivity map. The method can assist environmental and regional policy-makers in formulating the best-suited policies for growth and the environment in East Asia. The analysis showed that Japan is the only country that can be characterized as high productivity. Among the rest, China and Korea are high amenity, Singapore is low amenity and all the rest (Indonesia, the Philippines, Thailand, and Malaysia) are low productivity. Our findings suggest that the notion of sustainable development is best suited for the low productivity group of countries. Sustainable development maintains continuity of economic and social developments while respecting the environment without jeopardizing future use of natural resources. The old notion of
‘growth versus environment’ has given way to a new view in which economic development and environmentally sustainable practices go hand in hand.

Department of Economics, University of Crete

Department of Economics, University of Thessaly

Ministry of National Economy, Greece

ACKNOWLEDGEMENTS

We wish to thank two anonymous referees for helpful comments and suggestions on an earlier version of this paper. All errors remain our responsibility.

NOTES

1 See, for example, Solow (1956).
3 See Van der Ploeg and Tang (1992), for more details.
4 In Indonesia, Malaysia, Singapore, and Thailand.
7 All 120 experts originate from East Asian countries (12 from China, 3 from Indonesia, 35 from Japan, 21 from the Republic of Korea, 15 from Malaysia, 13 from the Philippines, 14 from Singapore, and 7 from Thailand). They have been involved in environmental economics or other related-sciences research projects in the last three years.
Hong Kong, Taiwan, Bahrain, and Sri Lanka were excluded because no data were available. This is because both slow- and fast-growing economies can suffer from severe environmental derogation.

REFERENCES


