ISSN 1323-8949
ISBN 0 7334 1575 X

THE UNIVERSITY OF
NEW SOUTH WALES

Economic Theory of Spatial Costs of Living Indices with Application to Thailand

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97/15

SCHOOL OF ECONOMICS

DISCUSSION PAPER

ECONOMIC THEORY OF SPATIAL COSTS OF LIVING INDICES WITH APPLICATION TO THAILAND

by

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Abstract

This paper deals with the issue of measuring the spatial costs of living and welfare indices. An axiomatic approach is used to develop these indices. The methodology developed in the paper is applied to Thailand data.

* I am grateful to Professor Murray Kemp for his helpful comments.

1. Introduction

It is often the case that costs of living vary between regions within countries. These variations have serious implications for comparing the welfare levels of households living in different regions. Despite this, welfare programmes in most countries are administered without making any adjustment for costs of living in different regions.

The most studies on poverty (also inequality) do not take account of spatial differences in cost of living. This has serious implications for design of policies and programmes to alleviate poverty (Thomas 1980). Some of those identified as poor in the low cost areas will be better off than those identified as non-poor in the high cost areas. Thus, we identify non-poor as poor and poor as non-poor.

This paper deals with the issue of measuring the relative costs of living among the various regions within a country. Despite the fact that this issue is important for many welfare policies, it has attracted a little attention in the economic literature.

There exists a vast literature on the economic theory of index numbers.[1] This theory has been developed to give a precise meaning to price indices which are widely computed to make costs of living comparisons over time. The spatial costs of living indices measure the relative costs of living in different regions and communities. This paper extends the economic theory of index numbers to construct spatial costs of living indices.

The most important objective of the paper, however, is to provide a methodology to compare welfare levels of households situated in different regions within a country. This problem is dual to the problem of measuring spatial cost of living indices. In this

[1] The most important contributions are those of Hicks (1946), Pollak (1971), Diewert (1976, 1980), Samuelson and Swamy (1974) and Konüs (1924).

paper, we have constructed spatial welfare (or real income) indices which take into account the differences in regional cost of living indices.

First, we develop our spatial costs of living and welfare indices under the assumption of bilateral comparisons. We propose a set of intuitively natural axioms which form the basis for arriving at our proposed indices. The major difficulty with these indices is that they vary with the basket which is used for making all possible bilateral comparisons. The methodology of bilateral comparisons is then extended to make multilateral costs of living and welfare comparisons in a symmetric manner.

The spatial costs of living and welfare indices are defined in terms a cost (or expenditure) function which is interpreted as the minimum cost of buying a given level of utility at given prices. To make these indices empirically operational, we consider the four alternative cost functions. These cost functions provide two alternative methods of computing the proposed indices.

The methodology developed in the paper is applied to compute the spatial costs of living and welfare indices in Thailand. The Department of Business Economics, Ministry of Commerce in Thailand provided the detailed baskets of 321 items of household consumption along with their average prices. We computed the spatial indices separately for rural and urban areas in five regions (Northern, Northeastern, Central, Southern and Bangkok and its vicinity).

2. The Cost Function

The conventional treatment of consumer choice is to maximize a utility function u(**q**) subject to the budget constraint $\mathbf{p}'\mathbf{q} \leq x$ where $\mathbf{q}' = (q_1, q_2, \ldots, q_n)$ is a non-negative vector of goods and services, $\mathbf{p}' = (p_1, p_2, \ldots, p_n)$ is a positive vector of prices

of n goods and services and x is the income available to the consumer. u(**q**) is the utility function which is increasing in q and is quasi-concave.

The solution to this maximization problem gives the Marshallian demand equations: $\mathbf{q} = q(x, \mathbf{p})$ which are homogeneous of degree zero in income and prices. Substituting the Marshallian demand equations into the utility function gives the indirect utility function: $u = \psi(x, \mathbf{p})$ which on solving for x in terms of u and **p** yields the cost (or expenditure) function

$$x = e(u, \mathbf{p}) \tag{1}$$

which is interpreted as the minimum cost of buying u level of utility at the price vector **p**.

The cost function will be the basis for measuring the spatial costs of living and welfare differences between regions. This function has the following properties.

1. $e(u, \mathbf{p})$ is an increasing function of u for all p.
2. $e(u, \mathbf{p})$ is an increasing and concave function of prices for all u.
3. $e(u, \mathbf{p})$ is (positively) linear homogeneous in p for every u, which implies

$$e(u, \lambda\mathbf{p}) = \lambda e(u, \mathbf{p}) \qquad \text{for} \quad \lambda > 0 \ .$$

3. Bilateral Comparisons

Suppose there are only two regions, for instance urban and rural, for which we wish to make comparisons of cost of living and welfare differences. We may call these regions as i and j. u_i and u_j are the average utility levels enjoyed by the ith and the jth regions, respectively. The region i has a higher (lower) level of welfare than the region j if u_i is greater (less) than u_j.

If x_i and x_j are the average money incomes of the regions i and j, respectively, then the usual method of comparing welfare of the region j relative to that of the region i

is given by $M_{ij} = x_j / x_i$, where $x_i = e(u_i, \mathbf{p}_i)$ and $x_j = e(u_j, \mathbf{p}_j)$; $\mathbf{p}_i$ and $\mathbf{p}_j$ being the price vectors for regions i and j respectively. This method would, of course, be valid if $\mathbf{p}_i = \mathbf{p}_j$. Since the regional price differences do exist, i.e., $\mathbf{p}_i \neq \mathbf{p}_j$, then M_{ij} cannot be used to measure the relative welfare levels of the two regions because it includes the effect of both the differences in costs of living and real welfare levels. To separate the two effects, we consider the following two indices:

$$P_{ij} = P(u_i, \mathbf{p}_i, u_j, \mathbf{p}_j) \tag{2}$$

and

$$S_{ij} = S(u_i, \mathbf{p}_i, u_j, \mathbf{p}_j) \tag{3}$$

where P_{ij} is the cost of living of the jth region relative to that of the ith region and S_{ij} is the welfare index of the jth region relative to the ith region.

It is then reasonable to assume that M_{ij} is a function of P_{ij} and S_{ij}:

$$M_{ij} = f(P_{ij}, S_{ij}) \tag{4}$$.

We may now propose the following axioms in order to be able to determine P_{ij} and S_{ij}.

Axiom 1: $P_{ij} = 1$ for all u_i and u_j if $\mathbf{p}_i = \mathbf{p}_j$.

This axiom implies that if all the prices in the two regions are exactly the same, the cost of living in the two regions must also be the same.

Axiom 2: $S_{ij} = 1$ for all $\mathbf{p}_i$ and $\mathbf{p}_j$ if $u_i = u_j$.

If the average utility levels enjoyed by people in the two regions are exactly the same, the two regions must enjoy exactly the same levels of welfare.

Axiom 3: If $P_{ij} = 1$, $M_{ij} = S_{ij}$ and if $S_{ij} = 1$, $M_{ij} = P_{ij}$.

This axiom is intuitively natural. It implies that if the two regions have the same costs of living, their relative welfare must then be equal to the ratio of their average incomes. Similarly, if the two regions enjoy the same levels of utility, then the ratio of their average nominal incomes would provide their relative costs of living. This axiom immediately leads to the following weaker axiom.

Axiom 3A: **If both** P_{ij} **and** S_{ij} **are equal to** 1**, then** M_{ij} **must also be equal to** 1**.**

Axiom 4: If $\mathbf{p}_j = \lambda \mathbf{p}_i$, then $P_{ij} = \lambda$ for $\lambda > 0$.

This axiom implies that if all prices in region j are λ times those in region i, then the cost of living in region j must also be λ times that in region i.

Axiom 5: $P(u_i, u_j, \mathbf{p}_i, \lambda \mathbf{p}_j) = \lambda P(u_i, u_j, \mathbf{p}_i, \mathbf{p}_j)$ and $P(u_i, u_j, \lambda \mathbf{p}_i, \mathbf{p}_j) = \frac{1}{\lambda} P(u_i, u_j, \mathbf{p}_i, \mathbf{p}_j)$, where $\lambda > 0$.

If all prices in region j change by a constant proportion λ, then the cost of living in region j relative to that in region i also changes by a constant proportion λ. Similarly, if all prices in region i change by λ, then the cost of living in region j relative to that in region i changes by a constant proportion $1/\lambda$, where $\lambda > 0$.

Axiom 6: $S(u_i, u_j, \lambda \mathbf{p}_i, \mu \mathbf{p}_j) = S(u_i, u_j, \mathbf{p}_i, \mathbf{p}_j)$.

This axiom means that inflation in either of the two regions does not affect the relative welfare levels in the two regions.

Axiom 7: $P_{ij} \cdot P_{ji} = 1$.

This axiom implies that the cost of living in region j relative to that region i must be equal to the reciprocal of the cost of living in region i relative to that in region j.

Axiom 8: $S_{ij} \cdot S_{ji} = 1$.

The welfare of region j relative to that of region i is reciprocal of the welfare of region i relative to that of region j.

$x_j = e(u_j, \mathbf{p}_j)$ is the minimum income that is needed to buy u_j level of utility at the prices of the jth region, i.e., $\mathbf{p}_j$. If we divide x_j by P_{ij}, we should obtain the real income of the jth region as $y_{ji} = x_j / P_{ij}$, which is the income required to buy u_j level of utility at the prices of the ith region, i.e., $\mathbf{p}_i$. $x_i = e(u_i, \mathbf{p}_i)$ is the minimum income required to buy u_i level of utility at $\mathbf{p}_i$ prices. This is in fact equal to the real income of the ith region in terms of the ith region prices which is y_{ii}. Obviously then S_{ij} which is defined as the welfare of the jth region relative to that of the ith region must be equal to y_{ji}/y_{ii}. This leads to the following axiom.

Axiom 9: $M_{ij} = P_{ij} S_{ij}$

This axiom will always satisfy Axioms 3 and 3A.

S_{ij} is the real income of the jth region relative to that of the ith region. We may compute the real income either at the ith region prices or at the jth region prices. Either of these base prices should give the same value of S_{ij}. Thus, we have the following axiom.

Axiom 10: $S_{ij} = \dfrac{y_{ji}}{y_{ii}} = \dfrac{y_{jj}}{y_{ij}}$

Since by definition, $y_{ij} = x_i / P_{ji}$ which in view of Axiom 7 gives $y_{ij} = x_i P_{ij}$ and similarly $y_{ji} = x_j / P_{ij}$ which immediately leads to Axiom 10. Although Axiom 10 is not an independent axiom but it is worth writing as a separate axiom because of its intuitive appeal.

4. A Solution

The Konüs (1924) cost of living index is widely used to make cost of living comparisons over time. Following the same idea, the cost of living index for any two regions may be made by an index P_{ij} given by $\log P_{ij} = \log e(u, \mathbf{p}_j) - \log e(u, \mathbf{p}_i)$ where u is the utility level which can take many possible values such as u_i or u_j or some average of the two. If we use either $u = u_i$ or $u = u_j$, Axiom 7 will be violated. To satisfy this axiom we propose that P_{ij} be given by

$$\log P_{ij} = \frac{1}{2}\left[\log e(u_i, \mathbf{p}_j) - \log e(u_i, \mathbf{p}_i) + \log e(u_j, \mathbf{p}_j) - \log e(u_j, \mathbf{p}_i)\right] \qquad (5)$$

To make welfare comparisons between the two regions, one can utilize the Allen (1949) quantity index S_{ij} as given by $\log S_{ij} = \log e(u_j, \mathbf{p}) - \log e(u_i, \mathbf{p})$ where $\mathbf{p}$ is the price vector which takes many possible values such as $\mathbf{p}_i$ or $\mathbf{p}_j$ or some average of the two. In order to satisfy Axiom 8, we propose the S_{ij} be defined by

$$\log S_{ij} = \frac{1}{2}\left[\log e(u_j, \mathbf{p}_i) - \log e(u_i, \mathbf{p}_i) + \log e(u_j, \mathbf{p}_j) - \log e(u_i, \mathbf{p}_j)\right] \qquad (6)$$

It can be easily verified from (5) and (6) that

$$\log M_{ij} = \mathrm{Log}P_{ij} + \log S_{ij}$$

which demonstrates that our proposed measures given in (5) and (6) will always satisfy Axioms 3, 3A and 9. Axiom 5 will be satisfied in view of the fact that the cost function $e(u, \mathbf{p})$ is (positively) linearly homogeneous. As a matter of fact, our proposed measures will satisfy all the Axioms proposed in the paper.

5. Multilateral Comparisons

We may now generalize the measures proposed in the previous section in order to make multilateral comparisons of relative costs of living and welfare levels. To do so we need to consider additional axioms. Suppose P_{ij}^* measures the cost of living of the jth region relative to that of the ith region when there are $m \geq 2$ regions. Similarly, S_{ij}^* measures the welfare of the jth region relative to that of the ith region in the presence of $m \geq 2$ regions.

The measures P_{ij}^* and S_{ij}^* should, of course, satisfy Axioms 1-10. We propose the following additional axioms.

Axiom 11: $P_{ij}^* = P_{ik}^* P_{kj}^*$ **for all** k = 1,2,...,m.

Axiom 12: $S_{ij}^* = S_{ik}^* S_{kj}^*$ **for all** k = 1,2,...,m.

These axioms imply that the measures should be transitive in all possible pairwise comparisons. The transitivity implies that all regions are treated symmetrically.

S_{ij}^* is the real income of the jth region relative to that of the ith region. The real income can be computed at the prices of any region. S_{ij}^* must be invariant to which region is chosen for computing the real income. This argument leads to the following axiom.

Axiom 13: $S_{ij}^* = \dfrac{y_{jk}}{y_{ik}}$ for all k = 1,2,...,m .

Suppose that y_{jk} is the per capita real income of the jth region computed at the prices of the kth region and if n_j is the population of the jth region, then

$$w_{jk} = \frac{n_j y_{jk}}{\sum_{i=1}^{m} n_i y_{ik}}$$

will be interpreted as region j's share of the total real income of the country (when the real income is computed at the prices of the kth region). Obviously, the real income share of any region must be invariant to which region is chosen for computing the real income. It means that w_{jk} must be independent of k. This leads to the following axiom

Axiom 14: $w_{jk} = \delta_j$ for all k = 1,2,...,m.

Note that although Axioms 13 and 14 are intuitively appealing but they are not independent of Axioms 7 and 11. As a matter of fact, Axioms 7 and 11 will always imply Axioms 13 and 14.

The next stop involves determining the measures that will satisfy all the fourteen axioms. The most important axioms in multilateral comparisons are the transitivity axioms 11 and 12. The bilateral measures P_{ij} and S_{ij} violate both these transitivity axioms. We may utilize the transitivity axioms to propose new measures P_{ij}^* and S_{ij}^* which will allow relative costs of living and welfare comparisons in situations of more than two regions. These measures are given by

$$\log P_{ij}^* = \frac{1}{m}\sum_{k=1}^{m}\log\left(P_{ik}P_{kj}\right) \tag{7}$$

and

$$\log S_{ij}^* = \frac{1}{m}\sum_{k=1}^{m}\log\left(S_{ik}S_{kj}\right) \tag{8}$$

where P_{ij} and S_{ij} are the measures of relative costs of living and welfare levels as defined in (5) and (6), respectively. Thus, the multilateral measures are derived from the bilateral measures. If we substitute m = 2, obviously then k will take only two values i and j. Equations (7) and (8) then immediately give $P_{ij}^* = P_{ij}$ and $S_{ij}^* = S_{ij}$ respectively. This shows that the bilateral measures are particular cases of multilateral measures.

Adding (7) and (8) gives

$$\log P_{ij}^{*} + \log S_{ij}^{*} = \frac{1}{m}\sum_{i=1}^{m}\left[\log\left(P_{ik}S_{ik}P_{kj}S_{kj}\right)\right]$$

which on utilizing Axiom 9 immediately gives

$$\log M_{ij} = \log P_{ij}^{*} + \log S_{ij}^{*}$$

which demonstrates that Axiom 9 relating to bilateral comparisons is also satisfied by our multilateral measures. This further implies that our multilateral measures also satisfy bilateral Axioms 3 and 3A. The transitivity Axioms 11 and 12 are always satisfied by P_{ij}^{*} and S_{ij}^{*} in view of Axioms 7 and 8 respectively. As a matter of fact it is not difficult to demonstrate that our proposed multilateral measures P_{ij}^{*} and S_{ij}^{*} will satisfy all the fourteen axioms when the bilateral measures P_{ij} and S_{ij} are as given in (5) and (6) respectively.

6. Specific Cost Functions

To make our measures of relative regional costs of living and welfare levels empirically operational we need to consider specific cost functions.

Linear Cost Function

Let us consider the cost function

$$e(u,\mathbf{p}) = a'\mathbf{p} + b'\mathbf{p}\cdot c(u) \tag{9}$$

where a and b are n×1 vectors of constants and c(u) is an increasing function of u.

Shephard's (1970) lemma states that

$$\frac{\partial e(u,\mathbf{p})}{\partial \mathbf{p}} = \mathbf{q}(u,\mathbf{p})$$

where **q** is the quantity vector providing utility level u at the price vector **p**. Applying this lemma on (9) gives

$$\mathbf{q}(u,\mathbf{p}) = a + bc(u)$$

which immediately gives

$$e(u_i, \mathbf{p}_j) = \mathbf{p}_j'\mathbf{q}_i \tag{10}$$

and

$$e(u_j, p_i) = \mathbf{p}_i'\mathbf{q}_j \tag{11}$$

which on substituting in (5) and (6) give

$$\log P_{ij} = \frac{1}{2}\left[\log \mathbf{p}_j'\mathbf{q}_i - \log x_i + \log x_j - \log \mathbf{p}_i'\mathbf{q}_j\right] \tag{12}$$

and

$$\log S_{ij} = \frac{1}{2}\left[\log \mathbf{q}_j'\mathbf{p}_i - \log x_i + \log x_j - \log \mathbf{q}_i'\mathbf{p}_j\right] \tag{13}$$

Note that P_{ij} and S_{ij} in (12) and (13) respectively are equivalent to Fisher's (1922) ideal price and quantity indices for making bilateral regional comparisons. Thus, P_{ij} and S_{ij} can be estimated from the price and quantity data available for each region. Having estimated P_{ij} and S_{ij}, we can utilize (7) and (8) to estimate the multilateral indices P_{ij}^* and S_{ij}^*.

Homothetic Quadratic Cost Function

A homothetic quadratic cost function can be written as

$$e(u,\mathbf{p}) = (\mathbf{p}'A\mathbf{p})^{\frac{1}{2}} c(u) \tag{14}$$

where c(u) is an increasing function of u and A is a symmetric matrix of constants.

Applying Shephard's lemma on (14) gives

$$\mathbf{q} = \frac{c(u)\cdot A\mathbf{p}}{\sqrt{\mathbf{p}'A\mathbf{p}}}$$

which yields

$$\log \mathbf{p}_i'\mathbf{q}_j = \log c(u_j) + \log(\mathbf{p}_i' A \mathbf{p}_j) - \frac{1}{2}\log(\mathbf{p}_j' A \mathbf{p}_j)$$

$$\log \mathbf{p}_j'\mathbf{q}_i = \log c(u_i) + \log(\mathbf{p}_j' A \mathbf{p}_i) - \frac{1}{2}\log(\mathbf{p}_i' A \mathbf{p}_i)$$

Substituting these equations in (14) and using symmetry property of A give

$$\log e(u_i, \mathbf{p}_j) - \log e(u_j, \mathbf{p}_i) = \log \mathbf{p}_j'\mathbf{q}_i - \log \mathbf{p}_i'\mathbf{q}_j$$

which on further substituting in (5) and (6) yields equations (12) and (13). Thus, this demonstrates that our proposed bilateral measures of regional relative costs of living and welfare levels lead to Fisher's ideal price and quantity indices when the cost function is homothetic quadratic.

Muellbauer's PIGLOG Cost Function

In 1975, Muellbauer proposed the price independent generalized logarithmic model (PIGLOG), the cost function of which can be written as

$$\log e(u, \mathbf{p}) = a(\mathbf{p}) + b(\mathbf{p})u \tag{15}$$

where

$$a(\mathbf{p}) = \alpha_0 + \alpha' \log \mathbf{p} + \frac{1}{2}(\log \mathbf{p})' A(\log \mathbf{p}) \tag{16}$$

$$b(\mathbf{p}) = \beta_0 + \beta' \log \mathbf{p} \tag{17}$$

where α and β are the n×1 column vectors of constants and A is the n×n matrix of constants such that $\alpha'\iota = 1$, $\beta'\iota = A\iota = 0$ and $A = A'$ (i.e., A is symmetric); ι being the n×1 vector whose all elements are equal to 1.

Utilizing the cost function in (15), (5) gives

$$\log P_{ij} = \alpha' D\mathbf{p}_{ij} + (\log \mathbf{p}_{ij}^*)' A D\mathbf{p}_{ij} + \bar{u}_{ij}\beta D\mathbf{p}_{ij} \tag{18}$$

where

$$D\mathbf{p}_{ij} = \log \mathbf{p}_j - \log \mathbf{p}_i,\ 2\log \mathbf{p}_{ij}^* = \log \mathbf{p}_i + \log \mathbf{p}_j$$

and

$$2\bar{u}_{ij} = u_i + u_j$$

Applying Shephard's lemma on (15) gives the vectors of budget shares

$$\mathbf{w} = \alpha + A(\log \mathbf{p}) + \beta u \tag{19}$$

where $\mathbf{w}$ is the n×1 vector of budget shares. Suppose $\mathbf{w}_i$ and $\mathbf{w}_j$ are the vectors of budget shares for the regions i and j respectively, then the average budget share defined as

$$\bar{\mathbf{w}}_{ij} = \frac{1}{2}\left(\mathbf{w}_i + \mathbf{w}_j\right)$$

will be given by

$$\bar{\mathbf{w}}_{ij} = \alpha + A \log \mathbf{p}^*_{ij} + \beta \bar{u}_{ij}$$

where use has been made of (19).

From (18), it can be seen that

$$\log P_{ij} = \bar{\mathbf{w}}_{ij} D\mathbf{p}_{ij} \tag{20}$$

which in view of Axiom 9 immediately gives[2]

$$\log S_{ij} = \log x_j - \log x_i - \bar{\mathbf{w}}_{ij} D\mathbf{p}_{ij} \tag{21}$$

Note that P_{ij} in (20) is the Tornquist (1936) price index which is used for making cost of living comparisons between any two periods. We have derived a similar index from a general PIGLOG cost function which allows us to make costs of living comparisons between regions.

The Translog Cost Function

The translog cost function is a second order approximation to a general cost function e(u,$\mathbf{p}$) and is written as

$$\log e(u, \mathbf{p}) = a(\mathbf{p}) + b(\mathbf{p}) \log u + \delta(\log u)^2 \tag{22}$$

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[2] Note that Tornquist's quantity cannot be used to measure the relative welfare levels because it will violate axioms 3, 3A and 9.

where a($\mathbf{p}$) and b($\mathbf{p}$) defined in (16) and (17) respectively and δ is a constant.

Utilizing the cost function in (22) in (5) gives

$$\log P_{ij} = \alpha' D\mathbf{p}_{ij} + \left(\log \mathbf{p}^*_{ij}\right)' AD\mathbf{p}_{ij} + \log u^*_{ij}\beta' D\mathbf{p}_{ij} \tag{23}$$

where $\log u^*_{ij} = \frac{1}{2}\left(\log u_i + \log u_j\right)$.

Applying Shephard's lemma in (22) gives the vector of budget share

$$\mathbf{w} = \alpha + A\left(\log \mathbf{p}\right) + \beta \log u$$

which gives the vector of average budget share

$$\overline{\mathbf{w}}_{ij} = \frac{1}{2}\left(\mathbf{w}_i + \mathbf{w}_j\right) = \alpha + A\left(\log \mathbf{p}^*_{ij}\right) + \beta \log u^*_{ij}$$

where $\mathbf{w}_i$ and $\mathbf{w}_j$ are the vectors of budget shares for the ith and jth regions respectively. From (23), it can be seen that P_{ij} is equivalent to the Tornquist (1936) price index as derived in (20). This demonstrates that the general translog cost function also yields the Tranquist price index. Since the translog cost function in (21) is a second order approximation to a general cost function, the relative regional costs of living and welfare indices derived in (20) and (21) respectively should provide reasonably accurate estimates of their true values. Having estimated the bilateral measures P_{ij} and S_{ij} for all possible values of i and j, the corresponding multilateral measures, viz., P^*_{ij} and S^*_{ij} are then easily obtainable from (7) and (8) respectively.

7. Spatial Costs of Living Indices and Real Income Indices for Thailand

In this section, we utilize the methodology developed in the paper to compute the spatial costs of living indices for Thailand. Thailand is divided into five main regions

1. Bangkok and its vicinity
2. Central region
3. Northern region
4. Northeastern region
5. Southern region

Each region except Bangkok is further divided into three areas, namely, municipal areas, sanitary districts and villages. Bangkok is entirely municipal.

The Department of Business Economics, Ministry of Commerce in Thailand uses various consumption baskets to compute price indices. These are detailed baskets consisting of 321 items of household consumption. In these baskets, there are 125 food items covering almost all items of food consumed by the population. These baskets are available for every region separately for sanitary districts and municipal areas. They are based on the survey data and are appropriate for the task at hand. The Department of Business Economics also provided us with average prices of each item in the baskets.

The spatial costs of living (and also relative real income) indices were computed for municipal areas and sanitary districts within each region (the total of nine distinct regions). Since the villages have not got organised markets, the village prices were not obtainable. We used sanitary district prices as proxy for village prices. This procedure is reasonable because people in a village do their purchases in the nearest sanitary district.

The spatial costs of living indices measure the relative costs of living in different regions and communities. The index value for Bangkok in 1992 is set equal to 100. The values of the index for other regions and areas are relative to Bangkok.

We have computed the relative costs of living indices using two alternative methods, one based on the linear cost function and the other one based on the translog cost function. The indices were first computed using the methodology of bilateral

comparisons. This methodology is not invariant to choice of a basket. The indices will vary with respect to the basket which is used for making all possible bilateral comparisons.

Tables 1 and 2 present the bilateral relative costs of living indices based on the linear and translog cost functions, respectively. The linear cost function completely ignores the substitution possibilities and, therefore, it may give biased estimates. The translog cost function, on the other hand, provides a second order approximation to a general cost function and, therefore, allows substitution possibilities.

It is noted that the relative costs of living indices are quite sensitive to which basket is used for bilateral comparisons. For instance, in Table 1, if Bangkok basket is used, the cost of living in the central urban is 88.9 percent of the cost of living in Bangkok. On the other hand, if we use the southern rural basket, the cost of living in the central urban area is 96.7 percent of that in Bangkok. Similar conclusions emerge from Table 2.

In view of the sensitivity of the choice of basket, it is important to compute the relative costs of living and real income indices using the methodology of multilateral comparisons. These indices are invariant to which basket is utilized and also satisfy the transitivity axiom. The empirical results are presented in Table 3.

An important conclusion that emerges from Table 3 is that the empirical indices are very similar for the two cost functions. It means that the substitution bias which has been widely emphasized in the literature is almost negligible.

The municipal areas (urban) of Bangkok and its vicinity have the highest cost of living. The rural areas generally have a lower cost of living. The lowest cost of living is found in the rural northern area following by the rural northeastern area, although the

Table 1: Relative costs of living indices based on bilateral comparisons
Linear cost function : Thailand 1992

Baskets/Prices	Bangkok Urban	Central Urban	North Urban	North-East Urban	South Urban	Central Rural	North Rural	North-East Rural	South Rural
Bangkok Urban	100.0	88.9	87.4	89.6	93.6	90.2	88.1	87.5	95.2
Central Urban	100.0	88.9	87.4	89.1	94.1	85.9	82.4	82.3	87.5
North Urban	100.0	88.9	87.4	89.2	94.4	84.9	81.0	82.4	85.0
North-East Urban	100.0	89.4	87.8	89.6	94.9	86.2	82.2	83.2	85.9
South Urban	100.0	88.4	86.6	88.4	93.6	84.5	79.8	80.2	86.2
Central Rural	100.0	93.3	92.8	93.7	100.0	90.2	87.7	87.8	92.2
North Rural	100.0	95.0	95.0	96.0	103.4	90.6	88.1	88.3	92.1
North-East Rural	100.0	94.5	92.8	94.1	102.2	89.9	87.3	87.5	90.7
South Rural	100.0	96.7	97.9	99.3	103.4	93.2	91.1	91.8	95.2

Table 2: Relative costs of living indices based on bilateral comparisons
Piglog and translog cost functions : Thailand 1992

Baskets/Prices	Bangkok Urban	Central Urban	North Urban	North-East Urban	South Urban	Central Rural	North Rural	North-East Rural	South Rural
Bangkok Urban	100.0	89.0	87.5	89.6	93.8	90.9	87.2	88.0	94.9
Central Urban	100.0	89.0	87.6	89.3	94.3	88.6	84.6	85.9	89.5
North Urban	100.0	89.0	87.5	89.3	94.6	87.7	84.0	85.8	88.0
North-East Urban	100.0	89.4	87.9	89.6	95.0	88.8	84.6	86.3	88.6
South Urban	100.0	88.6	86.8	88.5	93.8	88.3	83.6	85.2	90.6
Central Rural	100.0	91.3	90.7	91.8	96.6	90.9	88.5	88.6	92.8
North Rural	100.0	91.8	90.9	92.3	97.9	89.6	87.2	87.2	91.3
North-East Rural	100.0	91.2	89.8	91.5	96.9	90.3	88.1	88.0	91.1
South Rural	100.0	94.4	94.4	96.0	98.2	92.9	90.6	91.7	94.9

Table 3: Relative costs of living and welfare indices based on multilateral comparisons
Thailand 1992

Regions	Per household nominal income in baht	Relative nominal income index	**Linear cost function**		**Translog cost function**	
			Relative cost of living index	Relative welfare index	Relative cost of living index	Relative welfare index
Bangkok Urban	7782	100.00	100.00	100.00	100.00	100.00
Central Urban	7173	92.17	91.49	100.74	90.40	101.96
North Urban	6909	88.78	90.48	98.11	89.22	99.50
North-East Urban	6854	88.07	92.02	95.71	90.85	96.94
South Urban	6860	88.15	97.66	90.26	95.67	92.14
Central Rural	3178	40.84	88.36	46.22	89.77	45.49
North Rural	2675	34.38	85.22	40.34	86.46	39.76
North-East Rural	2831	36.37	85.59	42.49	87.41	41.61
South Rural	2499	32.12	89.91	35.72	91.27	35.19

difference between the two is almost negligible. After Bangkok and its vicinity, the southern urban area has the highest cost of living.

The results on relative real income (or welfare) indices show some interesting patterns. It is quite evident that the disparity of real income between rural and urban areas is extremely high. The relative nominal income index shows a greater degree of disparity between urban and rural areas. When adjustments are made for the relative costs of living differences, the disparity between urban and rural areas is reduced but it is still very high.

8. Some Concluding Remarks

In this paper, we have developed a new methodology to compute the spatial costs of living and welfare indices. The application of this methodology to Thailand data shows that costs of living vary substantially between the regions. Our analysis also shows that there exists a large welfare disparity between the urban and rural areas within each region of Thailand.

Our methodology is based on the assumption that the regions are homogeneous. It means that all the persons living within a region have the same level of utility. This is an unrealistic assumption particularly when our focus is on measuring relative welfare levels among the regions. An extention of the methodology will require a social welfare function for each region. This is a big task and will be attempted in a separate study.

For many policy purposes, we also require spatial costs of living indices for sub-group of commodities, such as food. To solve this problem, we will need the concept of sub-group cost (or expenditure) function. This issue will also be dealt with in a separate study.

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