SPATIAL INEQUALITY ANALYSIS WITHIN A REGIONAL GROWTH DECOMPOSITION TECHNIQUE INDONESIAN CASE 1976-1998

by

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Abstract

This paper introduces another perspective to analyze spatial inequality, in particular within the regional growth decomposition framework. The employed method brings about the spatial growth differencing as a measure of spatial inequality, an alternative to the regional conditioning principle (Quah, 1996). Results for the 1976-1998 case suggests that there is a tendency toward more spatial equality within Indonesian five super regions since the end of the 1980s. Thereafter, a Markov probability matrix is estimated, based on the regional differencing data. An interesting result here is that the current situation is not too far apart from the theoretical ergodic distribution. Although there is a relatively great degree of mobility, both in achieving equilibrium as well as at the steady state condition, only about half of the provinces will end up at within ± 3% difference with their neighbors' economic growth rate.

Keywords: Regional growth decomposition, spatial shift-share, regional inequality, Markov transition matrix, Indonesia.

JEL specification : R11, R12

Note

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1 Introduction

Regional inequality is usually presented as a study comparing economic performance of a particular region to that of a set of reference regions, typically the national economy or the average of the national economy. This paper offers another perspective of analyzing regional inequality. It sets as the reference regions those that are in interaction with the region under study. These regions can be called neighbors. In a more general term neighbors of a particular region may be viewed as another spatial entity whose existence is a function of the region under study. In this paper neighbors are spatially, or geographically, determined, hence is the term spatial inequality. Further, the relationship between a particular region and its neighbors is established within a growth decomposition framework, i.e., the spatial inequality will be analyzed using effects identified from the decomposition.

In particular we will use the so-called shift-share decomposition analysis[1] (Dunn, 1960) with its modification for spatial analysis, i.e., the spatial shift-share (Nazara and Hewings, 2002). As will be elaborated later, the spatial shift share considers the fact that a particular region is in interaction with its neighbors. In this interaction, neighbors may affect the region positively as well as negatively. The main advantage of this method is its simplicity in data processing as well as data requirements. These features are desirable for the technique's immediate and actual use by local economic decision makers, more importantly in the developing countries. The decomposition technique is relatively straightforward and requires relatively simple data for implementation that are usually available at regional level. While this paper will use income data, it is also possible to use employment data in the regional growth decomposition.

Simple as it may be, this decomposition of regional economic growth is a pattern-finding technique and is not meant to offer any causal relationship between the relevant effects with growth itself. Instead, the identified effects should be viewed as ones contributing to the observed regional growth rate. For example, the national effect in the standard shift-share analysis represents the contribution of the national economic performance in the regional growth achievement. That is to say that, for example, if the nation had a positive growth then it

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[1] This technique is introduced by Dunn (1960) and has been subsequently extended by many. Among them are Esteban-Marquillas (1972), Theil and Gosh (1980), Arcelus (1984), Patterson (1991), Dinc and Haynes (1999), Haynes and Dinc (1997), Knudsen (2000). Reviews on this technique can be seen in Stevens and Moore (1980) and recently in Stimson et al. (2002).

will contribute positively to the regional economy. That does not imply any causality in the sense that had the nation had a positive economic growth then the regional economy would actually enjoy the same positive growth.

This study falls under a broader heading of exploratory spatial analysis, whose main feature is that location matters to the outcome of the analysis. Thus, comparing a simple arithmetic average of income of various regions within a country does not constitute a spatial analysis simply because it does not inherently consider location. Different spatial configurations of the regions will not result in different regional average income, thus bringing about no change in the analysis outcome. Only when location matters, then the analysis embeds the spatial feature. Consider, for example, the difference in average income between a particular region with that of its neighbors. Different spatial configurations, bringing in different neighbor structures, will produce different outcomes on how far a region's average income is from its neighbors'. This study will explore the spatial inequality in a spirit of the latter example. Given a set of neighbor, i.e., a set of spatial entities with whom a particular region is in interaction, a region's economic performance will be analyzed by calculating the region-neighbors growth differentials.

The technique will be applied to the 1976-1998 provincial Indonesian data. The term neighbor is defined following the spatial configuration of Indonesian provincial system, where the 26 provinces in the country will be grouped into five super regions: Sumatra, Java and Bali, Kalimantan, Sulawesi, and Eastern Island. Interaction is assumed to take place among provinces within a super region, and not between. Such a regional categorization is supported by the data, and has direct policy relevance in the country's economic planning activity. The 1995 Interregional Input-Output matrix shows that intermediate input transaction are basically intra-, rather then inter-, regional. From the policy framework, the five major regions structure is basically the one used by the National Planning Agency (*Bappenas*) to conduct the the National Consultative Development Meeting (*Konsultasi Nasional Pembangunan* or *Konasbang*).

To analyze the regional dynamics of the growth decomposition, the Markov transition probability matrix will be estimated. This technique has received considerable attention in recent years, especially in the studies of regional convergence (for instance, see Quah 1996, Rey 2001, Le Gallo 2003). However, the Markov transition matrix that will be estimated here is different from the earlier attempt. First, the Markov transition matrix here will be estimated from growth, rather than level, of income variable. Secondly, the amalgamation of the spatial flavor in the Markov transition probability will be similar to one presented by Quah (1996). The difference is that the probability matrix that we are going to estimate here is based on the regional growth difference, rather than conditioned regional income. Further, several aspects about mobility will be examined for the estimated matrices.

This paper will be structured as follows. Section 2 aims at elaboration of the decomposition structure. The framework used to come up with the decomposition allows a much wider possibility of analyzing spatial inequality. Section 3 will present and analyze results of the spatial decomposition of provincial growth. In particular, the presentation will be focused on the effects in the regional and sectoral growth decomposition with spatial content. Section 4 will conduct the regional dynamics analysis. It will present and analyze the Markov transition probability matrices estimated from the spatial effects previously presented. Section 5 will be the conclusion, with closing remarks on some possible further studies.

2 Regional growth decomposition

This section describes the regional growth decomposition technique in a spatial context: the first part will discuss how a spatial configuration can be captured and translated into relevant variables, and the second part will outline the so-called spatial shift-share analysis, which is the vehicle to derive the notion of spatial inequality.

2.1 Representing the spatial effect

A particular province is assumed to be in interaction with its neighbors, which are considered as a separate spatial entity, but is not with other regions within the country. This structure can be depicted in an $R \times R$ weight matrix W, where R is the total number of provinces in the system. The typical element w_{rs} will be 1 if regions r and s are neighbors and 0 otherwise, with zeros in the main diagonal. The row sum of this matrix will denote the number of neighbors for a particular province. Due to the nature of the assumed spatial structure, all provinces in the same super region will have exactly the same number of neighbors.

Assuming the above spatial structure, the degree of interaction is spread out evenly among neighbors. The row-standardized weight matrix, denote this with $\tilde{W}$ with typical element $\tilde{w}_{rs}$, shows the degree of interaction between regions r and s. Higher values of $\tilde{w}_{rs}$ mean higher degree of interaction between the two regions r and s. This row-standardized weight matrix is useful to create the *spatial lag variable*. The spatial-lag of income is thus obtained by post-multiplying the row-standardized weight matrix with an $R \times 1$ vector of regional income y. The new vector $\tilde{y} = Wy$ contains the spatial-lag of income, where element $\tilde{y}_r$ is nothing but the arithmetic average of income of *r*'s neighbors.

Consider calculating the all-sector income growth rate for neighbors of a particular region *r*, denoted by g'_r. It is given by

$$g'_r = \frac{\left(\sum_{s=1}^{R} \tilde{w}_{rs} y_s^{\,t+1} - \sum_{s=1}^{R} \tilde{w}_{rs} y_s^{\,t} \right)}{\sum_{s=1}^{R} \tilde{w}_{rs} y_s^{\,t}} \tag{1}$$

where $\tilde{w}_{rs}$ is the element of row-standardized weight matrix $\tilde{W}$; $y_s^{\,t}$ and $y_s^{\,t+1}$ denote income at region *s* for time *t* and *t*+1, respectively. Correspondingly for a specific sector *i*, the growth rate for the *r*'s neighbor, denoted by $g'_{r,i}$, is given by

$$g'_{r,i} = \frac{\left(\sum_{s=1}^{R} \tilde{w}_{rs} y_{s,i}^{t+1} - \sum_{s=1}^{R} \tilde{w}_{rs} y_{s,i}^{t} \right)}{\sum_{s=1}^{R} \tilde{w}_{rs} y_{s,i}^{t}} \tag{2}$$

where everything is as previously defined and $y_{s,i}^{t}$ and $y_{s,i}^{t+1}$ are the regional sector *i*'s income for time *t* and *t*+1, respectively.

2.2 Growth decomposition with spatial effect

The growth rate of regional income for a specific sector *i,* denoted by g_i, is calculated as $g_i = (y_i^{t+1} - y_i^t) / y_i^t$, where *y* denotes income. We use a superscript to denote the time period and a subscript to denote a sector. The absence of a subscript *i* will denote a variable for all sectors. Thus, the growth rate of regional income for all-sector, denoted by *g*, is computed as $g = (y^{t+1} - y^t) / y^t$. Next, let capital letters denote the same variables at the national level. Therefore, the growth rate of income for all-sector at the national level *G* will be computed as $G = (Y^{t+1} - Y^t) / Y^t$. For a specific sector *i*, its growth rate at the national level will be calculated as $G_i = (Y_i^{t+1} - Y_i^t) / Y_i^t$.

To start with, note that $\Delta y_i = (growth)_i \times y_i$. The decomposition disaggregates the growth term Δy_i into several parts. A standard decomposition, known as the shift-share analysis, is as follows

$$(growth)_i \times y_i = [G + (G_i - G) + (g_i - G_i)] \times y_i \quad (3)$$

There are three effects at play that contribute to the regional growth of income for sector *i*. First is the *national effect*, represented by the term $G \times y_i$. This can be interpreted as the additional amount of income that the sector *i* in the region will enjoy if it follows the national all-sectors' growth rate. One can also interpret this effect as the contribution of the national economy as a whole to the growth of sector *i* at the particular region. Positive growth at the national level will yield a positive impact to the income growth for sector *i* at the regional level. The second effect is represented by the term $(G_i - G) \times y_i$, the *national industry-mix effect*. A region will acquire a significant national industry-mix effect if it specializes (in comparison to the nation) in a particular sector. The third effect, $(g_i - G_i) \times y_i$, is called the regional-shift effect. It quantifies the growth difference between the region and the nation.

The decomposition can be carried out strictly in terms of the growth part. This will be our approach when considering the decomposition with the spatial effects below. To incorporate the spatial effect, recall the spatial lag variables, given in (1) and (2), and consider the following decomposition structure:[2]

$$g_i \equiv \left[G + (g_i' - G) + (g_i - g_i') \right] \quad (4)$$

The first effect is similar to the standard shift-share, i.e., the national effect. The second effect is an industry-mix effect obtained by the difference between the sector *i*'s growth rate in the neighbor and the all-sector growth rate at the national level. This effect is called the *neighbor-nation industry-mix effect*. Positive values depict that sector *i* in the neighboring regions grows faster than the national all-sector growth rate. Thus, higher growth of sector i in the neighboring region, given *G*, will benefit to the particular region evaluate. In some sense, this neighbor-nation industry-mix effect captures the positive effect from neighbor's specialization in sector *i*. The third effect is called the *neighbor-region regional-shift effect*. A positive value is obtained if the sector *i*'s growth rate in the region under study is greater that that of its neighbor. Higher growth rate of sector *i* in the neighboring regions, given a certain g_i, will reduce this effect. In some sense, therefore, this effect captures the unfavorable effect that the neighbors may bring to the sector i's growth in the region under study.

[2] For a more compact presentation, subscript *r* is eliminated when no misinterpretation involved.

Note that the traditional industry-mix and regional-shift effects in (3), as well as the neighbor-region regional-shift effect in (4), measure the growth difference of just one aspect. For example, the tradition industry-mix effect $(G_i - G)$ measures the difference between sector *i*'s and all-sectors' growth rates, both at the national level. The regional-shift effect $(g_i - G_i)$ measures the difference between regional and national growth rates of sector *i*. And the neighbor-region regional-shift effect $(g_i - g_i')$ measures the difference between neigbhor's and regional growth rate also for sector *i*. As we are only measuring the difference in one particular dimension, the effect of this type is called a *simple effect*. This is to be contrasted to the neighbor-nation industry-mix effect, given in (4) by $(g_i' - G)$. This measures the growth difference between two aspects at the same time: between sector *i* and all-sector, and between the neighbor and the nation. Effect of this kind will be called the *combined effect*. As argued in Nazara & Hewings (2002), it is possible to express a combined effect in terms of series of simple effects, making use of the so-called step-by-step decomposition. In particular, the neighbor-nation industry-mix effect above can be re-stated as the following:

$$(g_i' - G) = (g_i' - g') + (g' - g) + (g - g_i) + (g_i - G_i) + (G_i - G) \quad (5)$$

where all variable are as previously defined. However, note that the step-by-step decomposition (5) reinvents two traditional effects shown in (3): the last two effects in (5) is nothing but the earlier industry-mix and regional-shift effects. A more appropriate name for the traditional industry-mix effect is the *national industry-mix effect* (since it measures the growth differential at the national level), and for the regional-shift effect is the *national-regional sectoral regional-shift effect*. The first three effects in the right hand side of (5) are new in the analysis. They are as follows:

1. *Neighbor industry-mix effect*, i.e., $(g_i' - g')$. This is the industry-mix effect of the neighboring regions. A positive (negative) value depicts the situation whether sector *i* grows faster (slower) than the all-sector in the neighboring regions.
2. *Neighbor-regional all-sector regional-shift effect*, i.e., $(g' - g)$. This effect compares a region's all-sector economy to its neighbor. A positive (negative) value here signifies the fact that the neighboring economy grows faster (slower) than the region under study.
3. *The negative of regional industry-mix effect*, i.e., $(g - g_i) = -(g_i - g)$. This is the industry mix effect at the region under study. A positive (negative) value depicts the situation whether sector *i* grows faster (slower) than the all-sector rate in the region.

Two final notes are in order for the step-by-step decomposition. Firstly, two or more adjacent simple effects in (5) can be combined together to produce a combined effect. For example the first two effects can be combined to produce $(g_i' - g') + (g' - g) = (g_i' - g)$. Secondly, the formulation (5) is not the only possible step-by-step decomposition for $(g_i' - G)$. One may alternatively choose the following structure $(g_i' - G) = (g_i' - g') + (g' - g) + (g - G)$. This is also a legitimate step-by-step decomposition as all of the three effects on the right hand side are simple effects. However, such a structure does not bring back the two traditional shift-share effects. Therefore, for the sake of conformity to the traditional shift-share analysis, the decomposition structure (5) is preferable.

Combining (4) and (5), we have a complete decomposition of regional growth rate in a spatial context, as the following

$$(growth)_i = \left[G + (g_i' - g') + (g' - g) + (g - g_i) + (g_i - G_i) + (G_i - G) + (g_i - g_i')\right] \qquad (6)$$

The above structure has three effects that allow one to carry out some spatial analysis of the regional growth decomposition. They are the neighbor industry-mix effect, neighbor-regional all-sector regional-shift effect, and neighbor-region regional-shift effect. Of these effects, the last two are of specific interest for spatial inequality analysis.

Note that the two spatial effects, i.e., the neighbor-regional all-sector regional-shift effect and the neighbor-region regional-shift effect, has some relationship with the idea of spatial conditioning (Quah 1996). The difference is in the method of conditioning: Quah (1996) uses the income relative, or ratio, while the two spatial effects we obtain earlier are essentially the spatial growth differences, one for the whole regional economy, and the other one for a specific sector. Below we will calculate and analyze these effects for Indonesian provinces during 1976-1998 period.

3 Regional inequality in Indonesia

As should have been clear from the above discussion on methodology, an important element of this regional inequality analysis is the underlying spatial configuration. In this study, Indonesia will be spatially considered as comprising five super regions: Sumatra, Java-Bali, Kalimantan, Sulawesi and Eastern Islands. There are eight provinces in Sumatra, six in Java-Bali (five in Java plus Bali), four in each Kalimantan and Sulawesi, and four in Eastern Island. The latter comprises provinces West and East Nusa Tenggara, Maluku and Papua. It is assumed that provinces within each super region are neighbors one with another but not with those in other super regions. There are two reasons for such assumption on spatial interaction. First, interregional intermediate input transaction is basically intra-, rather than interregional. This is shown in Table 1 which is derived from the 1995 Interregional Input-Output table. Second, from the policy framework, the five major regions structure is basically the one used by the Indonesian National Planning Agency (*Bappenas*) to conduct the National Consultative Development Meeting (*Konsultasi Nasional Pembangunan* or *Konasbang*). Aimed to synchronize the sectoral and regional development plan, this consultative meeting is part of a concerted effort to bring together the public and direct (domestic and foreign) investment plans. Analysis of spatial inequality, using the regional classification of the provinces and regions, will be a useful input for such consultative meeting.

Table 1. Intermediate input transaction by regions (in percentage)

Sending region	Destination region				
	Sumatra	Java & Bali	Kalimantan	Sulawesi	Eastern Island
Sumatra	89.9	9.3	0.6	0.1	0.0
Java & Bali	2.2	96.0	1.0	0.3	0.5
Kalimantan	0.3	13.6	84.9	0.9	0.3
Sulawesi	0.5	5.4	2.2	90.5	1.3
Eastern Island	0.3	12.7	3.1	4.8	79.2

Source: 1995 Indonesian input-output table

From the region's point of view, intra-regional development cooperation starts to receive greater attention. For an example, provinces in Sumatra have put together a regional initiative to promote economic development within the region. Such initiatives involve series of coordination aiming at the development of transportation infrastructure such as airlines, sea lines, and trans Sumatra railway. Another initiative covers the information technology, aiming at linking policy makers at all levels –province, districts and municipalities– in the region. This type of initiative is another justification of the spatial interaction assumed in this paper.

This paper will examine the regional inequality in three major sectors: primary (agriculture and mining & quarrying), secondary (manufacturing, construction, and utilities) and tertiary (services). The Indonesian Central Bureau of Statistics releases the income data in several publications, and the growth rates are calculated using 1993 constant prices.

Panels (i)-(v) in figure 1 presents the neighbor-region sectoral regional-shift effects for each super region in Indonesia during the 1976-1998 period. In each panel, we plot the provincial averages of neighbor-region for each sector in study. There are several observations that visually stand out from figure 1.

First, there is a general tendency for fluctuations of the regional-shift effect in the 1990s to be smaller than those in the earlier period. This is visible for all sectors in all super regions, more importantly in Kalimantan. This suggests that there is a greater spatial equality within the five super regions in Indonesia during the 1990s than in earlier years. In the case of Kalimantan, the significant fluctuation in the primary and secondary sectors might be due to oil and gas production in the region: the mining and quarrying sector is included in the primary while the oil refinery is part of the secondary sector.

Secondly, among the three sectors, the tertiary sector generally seems to be one closest to zero percent. This suggests that tertiary sector in provinces within Indonesian super regions are relatively similar one with another, i.e., more equality with respect of the tertiary sector within Indonesian super regions. This feature may be generated by the fact that the greater part of Indonesia is not yet very much service-oriented. In Java, the most developed super region thus the most service-oriented super region, the fluctuation of this effect is the greatest among the super regions especially in the 1980s and early 1990s. In other regions, however, where services are not the major part of the income, their fluctuations are relatively limited.

(i)

(ii)

(iii)

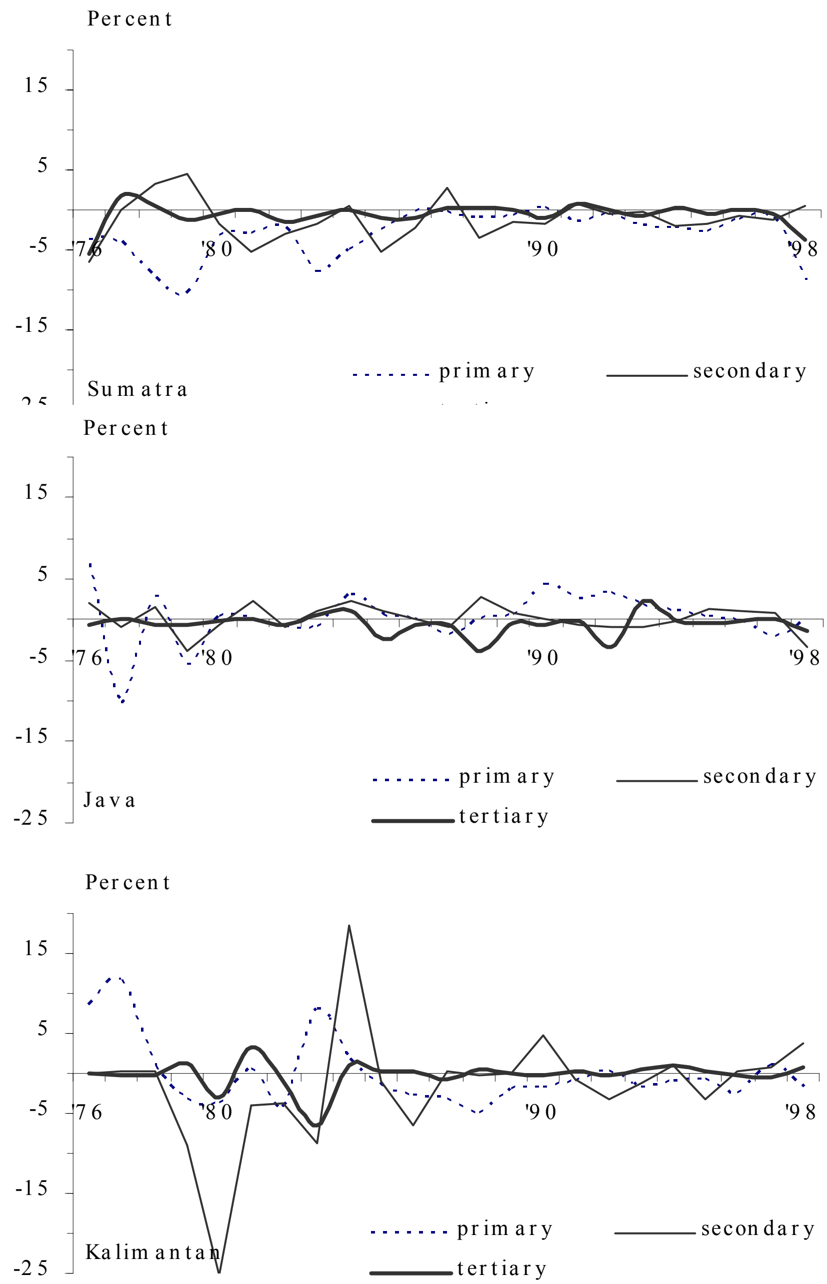
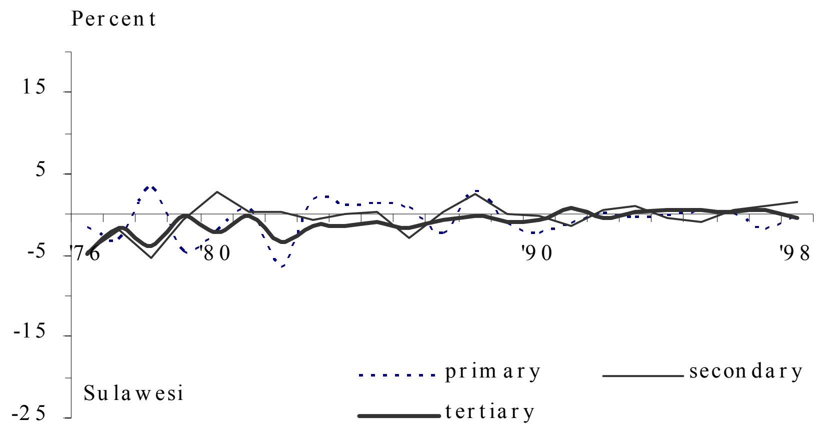


Figure 1. Neighbor-region sectoral regional-shift effects , 1976-1998 Indonesian super regions: (i) Sumatra, (ii) Java, (iii) Kalimantan, (iv) Sulawesi, and (v) Eastern Island

(iv)



(v)

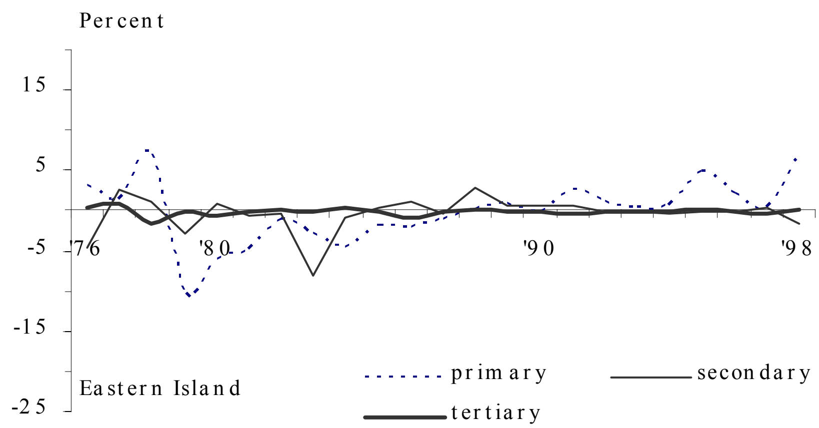


Figure 1 (cont.) Neighbor-region sectoral regional-shift effects $(g_i - g_i')$, 1976-1998 Indonesian super regions: (i) Sumatra, (ii) Java, (iii) Kalimantan, (iv) Sulawesi, and (v) Eastern Island

To compare the overall spatial inequality, figure 2 shows the annual average of neighbor-region all-sector regional-shift effect for each super region in Indonesia. Confirming earlier observations from figure 1, here we again witness a more stable spatial inequality trend after, and not before, the end-1980s. After the mid-1980s, regional-effects are primarily within ± 2 percent interval, suggesting relative equality within, as well as between, super regions.

An interesting pattern is apparent during the crisis years: 1997-1998. Kalimantan and Eastern island move toward greater inequality, Sumatra and Java move in the reverse direction, and Sulawesi seems stable at the relatively equality line. This may be related to the crisis-related economic contraction that takes place primarily in the urban areas of the western part of Indonesia, primarily Java island. On the other hand, some non-Java areas receive some benefit from the currency depreciation through the increases in values of exportable goods, primarily oil and gas production, and tradable cash crops.

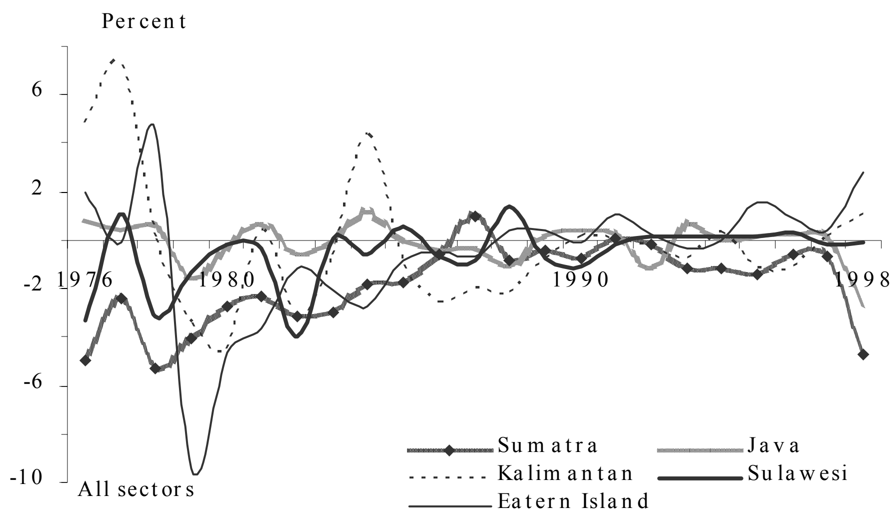


Figure 2. Neighbor-region all-sector regional-shift effects $(g' - g)$, 1976-1998
Indonesian super regions: (i) Sumatra, (ii) Java, (iii) Kalimantan,
(iv) Sulawesi, and (v) Eastern Island

What has been accomplished this far is the decomposition of the sectoral growth rate at the provincial level together with relevant spatial effects. The temporal analysis of these effects, however, so far primarily relies on visual observation. A better method to study the regional dynamics is appropriate here. This will be the topic of the next section where we put the growth rate and the regional-shift effects in a Markov transition probability matrix.

4 Regional dynamics

Recent studies on regional dynamics have employed a Markov transition probability matrix. We are also going to adopt the approach here. More specifically, in this part, we are going to estimate and analyze the annual transition matrices, one for each sector as well as for the total, for Indonesian provinces during the 1976-1998 period.

The Markov transition probability matrix will be estimated based on the neighbor-regional all-sector regional-shift effect $(g' - g)$, and neighbor-region regional-shift effect $(g_i - g_i')$. Therefore, the typical entry $m_{i,j}$ in the estimated transition matrices should be interpreted as the probability of a region in a growth differential class *i* at time *t* to be at the growth differential class *j* at time period $t+1$. This is different from the specification by Rey (2001) or Le Gallo (2003) that puts spatial configuration in the class category of the matrix. Here, there is no spatial configuration in the class specification. In this respect the probability matrix that we are going to estimate here resembles the one proposed by Quah (1996), which is based on spatially conditioned data. In our framework, instead of spatially conditioned, we have a spatially differenced dataset.

There are several features that will be examined from each of the Markov transition probability matrix. First is the degree of mobility. This allows us to examine how likely it is for a region to move between classes. There are several proposed measures for this mobility (Shorrocks 1978, Geweke et. al 1986, Maasoumi 1998). Four indices will be used to measure the degree of mobility in the transition probability matrix. The first is the Prais index = $[k-tr(M)]/(k-1)$, where ***tr*** is the trace operator. This index gives indication about the nature of speed toward the convergence state. The value of this index ranges between [0,1.25] with higher value indicating greater speed toward the equilibrium. The second index is the asymptotic half-life index, given by $h=-\log 2/\log|\lambda_2|$ where λ_2 is the second largest eigenvalue of the probability matrix. This index indicates the time periods needed to move halfway toward the equilibrium. This indicator ranges between positive infinity (when $\lambda_2=1$, meaning that a stationary state does not exist) and zero (when $\lambda_2=0$, meaning that the estimated matrix has reached the equilibrium state.) The third index is the unconditional probability of leaving the current class, given by $[k/(k-1)]\Sigma_i F_i^*(1-m_{ii})$. Movement between classes does not only take place during the path toward convergence state, but can also take place once the convergence is reached. This indicator measures the probability of leaving the current class once the system has reached the equilibrium state. Finally, the mean first passage time, given by $F^{*\prime}M_P F^*$, where M_P is the mean first passage time matrix, and F^* is the ergodic distribution. This index indicates, for two randomly selected observations, the expected number of periods needed for the first observation to arrive at the class of the second one. This indicator also measures movement in the equilibrium state, since it uses the ergodic distribution F^*. The ergodic property comes from the limiting matrix M^*, where $M^*=M^N$ for some *N*, and M^N of rank 1. This ergodic distribution is also given by the eigenvector associated with the unit eigenvalue of *M*.

The choice of classes is always problematic in the estimation of the Markov transition probability matrix. There are four classes identified for the spatial growth difference variable: less than –3%, between –3 and 0%, between 0 and 3%, and greater than 3%. In the absence of spatial inequality, then the regional-shift effects, i.e., growth difference, should be very close to 0%. Spatial equality will be the equilibrium state if the matrix shows a greater probability for a region to end up in the two middle classes.

As can be seen from the matrices, the probability of over time movement between classes is much greater than that to stay within the original class. In fact none of the class, for all sectors as well as for the whole, has a probability to stay within the class of greater than 0.5. A region has a greater chance of changing class than staying. The values of the Prais index for the probability matrices are greater than 0.8 which is relatively high in the [0,1.25] range of this index. While the Prais index indicates the extent of movement in the path toward the equilibrium, the 'unconditional probability of leaving the current class' index gives an indication about movement at the equilibrium condition. Again, the degree of mobility is relatively high. The 'unconditional probability of leaving the current class' says that there is more than 80% chance that a region will move between classes even in the equilibrium state.

What does the above result suggest? It suggests that a region's economic position relative position within a super region is volatile. A region can have relatively better position than the other on one period, but worse in the next period. On the other hand, there is a long term general belief about the relative position of some provinces within the whole Indonesia. For example, it is believed that Nusa Tenggara provinces, especially the East, are among the poorest province in Indonesia. However, the above results have shown that when we compare the province to its 'own league', the belief is not necessarily uphold. The relative position of a province is likely to change from one period to another.

Let us take the growth differential between –3 to +3% as the interval of equality. That is, when a region is in this growth differential interval from others then the situation is considered equal. Note from the ergodic distribution that the percentages of those in this interval are about 38% for primary, 34% for secondary, 55% for tertiary, and 52% for the whole sector. This suggests that the tendency for the system to arrive at regional equality is relatively weak. The small percentage for the primary sector may be caused by the endowment factor, i.e., not all provinces are endowed with fertile land or mining deposits. However, the small percentage for the secondary sector does indicate unequal distribution of development across Indonesian provinces.

Primary Sector

Classes	< -3%	-3 – 0%	0 – 3%	> 3%	# observation
< -3%	0.451	0.199	0.150	0.199	206
-3 – 0%	0.391	0.304	0.165	0.139	115
0 – 3%	0.219	0.177	0.281	0.323	96
> 3%	0.277	0.155	0.155	0.413	155
Initial dist.	0.360	0.201	0.168	0.271	
Ergodic dist.	0.351	0.205	0.178	0.266	

Prais index = 0.850 Prob. Leaving current classes = 0.826
Half-life period = 0.477 Mean first passage time = 4.550

Secondary Sector

Classes	< -3%	-3 – 0%	0 – 3%	> 3%	# observation
< -3%	0.450	0.106	0.101	0.344	189
-3 – 0%	0.198	0.302	0.281	0.219	96
0 – 3%	0.253	0.295	0.253	0.200	95
> 3%	0.318	0.094	0.141	0.448	192
Initial dist.	0.330	0.168	0.166	0.336	
Ergodic dist.	0.330	0.167	0.170	0.333	

Prais index = 0.849 Prob. Leaving current classes = 0.812
Half-life period = 0.654 Mean first passage time = 4.650

Tertiary Sector

Classes	< -3%	-3 – 0%	0 – 3%	> 3%	# observation
< -3%	0.385	0.224	0.175	0.217	143
-3 – 0%	0.213	0.355	0.312	0.121	141
0 – 3%	0.176	0.212	0.388	0.224	170
> 3%	0.220	0.237	0.288	0.254	118
Initial dist.	0.250	0.247	0.297	0.206	
Ergodic dist.	0.246	0.257	0.296	0.202	

Prais index = 0.873 Prob. Leaving current classes = 0.864
Half-life period = 0.441 Mean first passage time = 4.656

All Sector

Classes	< -3%	-3 – 0%	0 – 3%	> 3%	# observation
< -3%	0.485	0.242	0.139	0.133	165
-3 – 0%	0.204	0.370	0.253	0.173	162
0 – 3%	0.203	0.289	0.344	0.164	128
> 3%	0.197	0.205	0.222	0.376	117
Initial dist.	0.288	0.283	0.224	0.205	
Ergodic dist.	0.281	0.282	0.236	0.200	

Prais index = 0.808 Prob. Leaving current classes = 0.803
Half-life period = 0.551 Mean first passage time = 4.748

Table 2. The estimate Markov transition probability matrix
for neighbor-region regional-shift effects, Indonesian provinces 1976-1998.

Surprisingly the ergodic distribution is not very far from the existing or initial distribution, meaning that the existing estimation is not very far from the equilibrium distribution. The asymptotic half-life index shows that it takes less than a period to cover the halfway distance toward the equilibrium. This means that, without significant policy changes, we will witness current distribution characterizing Indonesian regional income distribution in the future.

5 Closing remarks

This paper has presented a method to analyze the notion of spatial inequality within a growth decomposition framework. The spatial notion is brought into the model by having a weight matrix and constructing the growth rate of the neighbors. The growth decomposition technique proposed here, called the spatial shift-share analysis, introduces the neighbor-region regional-shift effects or, simply, the spatial growth differentials, which subsequently is analyzed using the Markov transition probability matrix. In contrast to several earlier attempts analyzing regional dynamics, the Markov transition probability matrix here is based on the growth rather than level of income.

The application to 1976-1998 Indonesian provincial data provides an example of how the analysis can be conducted. The Markov transition matrices for the spatial effects show that there is a great degree of mobility in the Indonesian case, both in the path towards the equilibrium as well as at the theoretical equilibrium state. Another important finding is the fact that the current situation is not very far apart from the steady state condition. Any attempt to arrive at different steady state conditions will warrant an active policy intervention different from what is exercised during the study period.

There are several paths in how this analysis can be extended. First, as expressed in the introduction, this regional growth decomposition is strictly a pattern finding method. The next logical step is to provide an explanation why such a pattern arises. The attempt will also have to take into account location more formally. Methodologically speaking, spatial econometrics will offer an appropriate framework for such an attempt. One immediate complication for such attempt is the fact that the spatial decomposition of the growth rate combines three effects at the same time: regional, sectoral, and time series. Second is about the definition of neighbors. In the introduction we mention that, in a more general term, neighbors of a particular region may be viewed as another spatial entity whose existence is a function of the region under study. This paper defines the neighbors spatially. Alternatively, a broader term interaction may expand beyond the spatial configuration. It can take into account economic interaction as well. Having mentioned that, it is possible to construct the economic neighbors of a particular region, i.e., a set of regions within the country with whom that particular region is in economic interaction.

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