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Sources of growth in income and inequality among ethnic groups in Malaysia for 1970-2000

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Abstract

This paper examines sources of income growth over the period 1970-2000, with emphasis given on income distribution among major ethnic groups in Malaysia. The framework within the analyses are carried out is a structural decomposition analysis (SDA), applied to a socio-economic system which represented by a social accounting matrix (SAM). It offers a wide-decomposition analysis, separates out the income changes into the effects that determined primarily by production structure and secondarily through re-distribution mechanism. Results consistently indicate that expansion in exports and technological change in using labor and capital are the main determinants for the income changes for all individual ethnic groups. In relative measures however, these two determinants (as well as other determinants) have limited effects on the Malay compared to the Chinese and Indian. The similar outcomes hold for the effects on employment changes. The reason for differences is that a large number of Malay workers are employed in the public services sectors, the sectors which have limited structural changes and low productivity. In one hand, inequality has been reduced through extensive government supports but on the other hand, it is not a sustainable income growth for the Malay.

Keywords: income distribution, social accounting matrix (SAM), structural decomposition analysis, ethnics

JEL codes: C67, D30, O15

1. Introduction

Changes in economic structures that characterised by the changes in structures of production output, are often identified as an important source of changes in distribution of income. There are several factors that contribute to the changes in the structures of production output and those factors can affect the distribution of income directly through demand of labor. Changes in patterns of trade and technological specialization usually have been identified as the main causes for labor changes, which in turn affect distribution of income (see, for example, Cook and Uchida, 2008; Manasse and Turrini, 2001 for effects of trade, Kijima, 2006; James and Khan, 1997 for effects of technological change).

This paper offers a comprehensive analysis, decomposes the underlying causes for the changes in income into detailed components by the means of a structural decomposition analysis (SDA, see Dietzenbacher and Los, 1998). The framework within the analysis is carried out is a socio-economic system which represented by a social accounting matrix (SAM). Although a SAM includes information from input-output tables, applying the SDA requires a non-trivial extension of the methodology. As a matter of fact, we are not aware of any other studies that have attempted to apply the SDA into a SAM. One interesting aspect of a SAM is that it provides a wide-decomposition analysis of income, by integrating not only primary income effects that are determined by production structure (e.g. export and investment) but also secondarily through a re-distribution process (e.g., institutional transfer).

We run two SAMs for Malaysia for 1970 and 2000, the periods that can be supported by the availability of data. Uniquely, the SAMs include detailed information on ethnic groups, which comprise the Malay, Chinese, Indian and a group of other ethnic minority groups (simply defined as a group of "other")[1]. Therefore, our results aim to provide some insights into the causes for the changes in income across the ethnic groups in general and the issue of income distribution in particular. An assessment of the existing literature suggests that no attempts aimed at chronicling the income changes at disaggregated household groups have been studied but, decomposition of aggregate income changes has been conducted (see, for instance, Oosterhaven and Hoen, 1998; Oosterhaven and van der Linden, 1997). It should be emphasized that analyses of income distribution at an aggregate level may well produce different outcomes than measurement at disaggregated level due to aggregation bias.

From a policy point of view, including the period 1970 in the analyses may provide an interesting discussion. This is because 1970 was the starting point of Malaysia's economic transformation from

[1] The major ethnic groups in Malaysia are Malay (indigenous, 60% of the population in 2005), the Chinese (23%), Indian (7%), a group of other ethnic minority groups (1%) and non-citizen household (9%)

development strategies with an emphasis purely on economic considerations towards affirmative policies based on the combinations of economic and distribution strategies. The policy shifts were initiated as a result of the bloody communal riots in May 1969, which highlighted the dangers inherent in multi-racial societies when ethnic prejudices were exacerbated by economic imbalances. Therefore, three decades after the implementation of policy reforms could be evaluated.

The remainder of this paper is organised as follows: Section 2 briefly reviews broad economic policies that were implemented between 1970 and 2000. It then links the implemented policies with growth and distributional achievements within the periods. Section 3 briefly explains general structures of our SAMs and procedures for the deflation of the SAMs into constant prices. Section 4 discusses the technical details of our decomposition analysis that applied to the SAMs. Section 5 presents results of the decomposition analysis of income changes. Finally, section 6 summarises some important conclusions drawn from the study.

2. Economic Policies, Growth and Income Distribution, 1970-2000

Economic expansion during the period 1957-1969 (post-independence), although respectable, failed to make substantial contributions towards solving the "special" problems of the Malay (indigenous group), especially on the issue of economic welfare. Although the political power is dominated by the Malay, the economic activities are run mostly by the non-Malays. This leads to the non-Malays question the extent to which their interests are being safeguarded in Malaysia. The disenchantment that had been growing among all segments of the population ultimately erupted in the bloody ethnic riots in May 1969. As a result, economic policies shifted from planning, based on purely growth considerations, towards affirmative policies based on growth with equal distributions. The policy shifts were formalised in the New Economic Policy (NEP), 1971-1990 (see, Economic Planning Unit, various years).

The objectives of the NEP are to achieve national integration and unity through a two-pronged strategy: eradication of poverty irrespective of ethnic groups and restructuring of the society with a view to eliminating the identification of ethnic groups with economic functions[2]. For the first objective, the overall development strategy was reformulated by emphasising export-oriented industrialisation

[2] Under colonial labour policy of 'divide and rule', introduced by British (1786-1942), the Chinese and Indian were segregated from each other and from the Malay community by economic activity and location. The Chinese and Indian were allocated and engaged in the commercial and industrial activities areas whereas the Malay was engaged in traditional sector of peasant agriculture and fishing. The Malay was only allowed to involve in modern economic activities as civil servant, i.e., policy and military forces (for more information see Faaland, et al., 2003).

and ambitious rural and urban development programmes. For the second objective, long-term targets were established for the Malay ownership of capital share in limited companies, and the proportion of Malay employed in industries across managerial positions. Among the strategies that are formulated to achieve the NEP objectives were promotions of Malay participation in business through the expansion of the public sector, where the Malay holds most of the key positions, and by providing them with privileged access in the private sectors. The Industrial Coordination Act (ICA), for example, was introduced to strengthen measures of Malay participation in medium- and large-scale enterprises by ensuring that the composition of employment reflects ethnic compositions.

To evaluate implications of the NEP policies, we present sectoral growth rates and their percentage shares to the gross domestic product (GDP) in Panel A and B of Table 1. We observe that the economic growth during the period of NEP was impressive. For example, over the period of 1970-1990, the economy on overall, expanded at an average rate of 12% per annum (in current prices). Rapid economic growth during this period was accompanied by a considerable transformation of the economic structure from being agriculturally based to the industrially based. The fact is that percentage in the share of the manufacturing sector to the GDP increased sharply from 14% in 1970 to 24% in 1990 (see Panel B). In turn, the share of the agriculture sector to the GDP declined from 32% in 1970 to 15% in 1990. The expansion of the manufacturing sector is strongly accompanied by an outward policy orientation, that is, by export-led growth. The contribution of this sector to total exports increased rapidly from 12% in 1970 to 85% in 1990 (Zakariah and Ahmad, 1999). Exports of manufacturing products during this period, especially in the early 1970s and 1980s, were largely supported by the expansion in the exports of resource-based products such as food, beverages, tobacco, and wood products.

<Insert Table 1>

For implications of the NEP policies on income, we compile published average monthly household income and their growth rates in Panel C and D of Table 1. The main observation here is growth and structural transformation of the economy during the NEP period has positive implications for the distribution of income. For instance, the average monthly income of Malay increased significantly from 172 MR (*Malaysian Ringgit*) in 1970 to 940 MR in 1990. As a consequence, income inequality among the major ethnic groups—Malay, Chinese and Indian had been declined. Setting the average income Malay at 100, we find that income ratios for the Chinese reduced from 229 to 174 while that of Indian improved from 177 to 129. Similarly, a huge income gap between rural and urban households was reduced from 214 to 170 (setting average income of rural households at 100).

Industrialisation through promotion of export of labor-intensive products can be put forward to explain for the success in narrowing the income gap. The manufacturing sector not only contributes a large share of export but also is the major source of employment expansion. For instance, the capacity of this sector to absorb employment increased from 14% in the mid-1970s to over 25% in the mid-1990s (Athukorala and Menon, 2002). As a labor-abundant developing country**,** therefore, the outward-looking policy, by promoting export of labor-intensive products, has proven to be the most effective strategy for improving income, which in turn, could potentially reduce income inequality.

During the period of 1991-2000, the economy was driven by the National Development Policy (NDP), which seeks to maximise economic growth through a policy that allows for free play of market mechanisms and active participation of private sectors (see, Economic Planning Unit, various years). For example, the Promotion Investment Act (1986) was introduced in order to attract more foreign capital inflows and more generous incentives for private investors. The reforms also involved a gradual process of privatisation and restructuring of state-owned enterprises. These market-oriented policy reforms were accompanied by a strong focus on restoring and maintaining macro-economic stability, and meeting the infrastructure needs for a rapidly expanding economy.

The approach that the government has adopted towards income distribution also has changed, especially on policies related to the Malay. The support now comes in the form of assisting the Malay community to compete more confidently with other ethnic groups, without being too dependent on the government. As a result, the government, for example, relaxed regulations on foreign equity participation in the country and liberalized parts of the ICA. For example, requirements of industries to have employment structure based on ethnic compositions were released.

During the NDP period, the economy was still driven by the manufacturing sector, but the emphasis was changed from the resource-based to the non-resource-based export-orientation. Consequently, by the late 1990s, the share of resource-based exports declined whereas the share of non-resource-based exports, such as electronics, electrical machinery and appliances, rose sharply as the economy moves into the promotion of heavy industries (Zakariah and Ahmad, 1999). The major structural shift within the sector, and perhaps in the economy as a whole, was the emergence of electric and electronic sub-sectors as the leading exports. Its share of the total exports increased significantly from 9% in 1978 to 53% in 2000 (Department of Statistics, DOS, 2004). As a consequence, the traditional engine of growth, the agriculture sector, became less significant, with the growth rate of this sector dropped dramatically from 8% per annum in the period 1970-1990 to 5% per annum in the period 1990-2000 (see Panel A).

In term of income growth, income for all ethnic groups has increased, but the income inequality did not show a substantial improvement compared with the period of NEP. Setting the average income of Malay at 100 again, we observe that income ratios for the Chinese in 2000 remain unchanged as it was in 1990 (i.e. 174) and that of for the Indian slightly worsened to 136. The explanation for the inequality is the differential rates of the income growth among the ethnic groups. As indicated in Panel D, income growth for the Malay and Chinese almost the same at 7% whereas that of the Indian was higher at 8%. Also, the increase in income gap between rural and urban households can be explained through a similar reasoning.

Overall, implications of economic growth and transformation between 1970 and 2000 on distribution of income are satisfactory, although efforts to bring about inter-ethnic income equity are slightly more impressive during the period 1970-90. Between 1970 and 2000, the growth in average income for the Malay increased by 8%, which is higher than the Chinese and Indian at 7%. Thus, our main tasks here are to identify what are the factors or determinants that contribute largely to the income growth? And how these determinants have affected income differently across ethnic groups, which in turn could have implication on inequality? Our decomposition framework in the next section can be used to answer these empirical questions. From a policy point of view, the analysis would be more useful if we are able to determine the sources of income growth for two sub-periods, between 1970 and 1990 (NEP period), and between 1990 and 2000 (NDP period). However, unavailability of data limits our analyses between 1970 and 2000.

3. Social Accounting Matrices and Deflation Procedures

3.1 *The 1970 and 2000 SAMs*

Two Malaysian SAMs for 1970 and 2000 are used to analyse the sources of income changes[3]. It has been recognized that structures of a SAM may vary from one to another, depending on the policy focus and to a degree that can be supported by data. Similarly, the structures of 1970 and 2000 SAMs are not consistent because of differences in terms of designs and classifications. Specifically, the 1970 SAM comprises 11 sets of accounts, namely the want, factor of production, household, company, government, consolidated capital, current and capital for the rest of the world, commodity and activity for production and indirect tax. The 2000 SAM contains nine sets of accounts by having only a single

[3] See Pyatt and Round (1984) and Saari et al. (2007) for more details description of the 1970 and 2000 SAMs. In 1970 SAM, there are separate accounts for Peninsular Malaysia in the west and the states of Sabah and Sarawak in the east Malaysia. For purpose of this study, we only consider a national SAM as a dataset.

account for production and excluding the account of want. The rest of the accounts are similar with respect to the former one.

There are two main differences between the former and the latter SAMs. The first difference is with respect to the treatment of the consumption of commodities by households. Usually, consumption of commodities by households is shown directly by the household account as expenditures to the production account. Beyond this scheme, the consumption of commodities is converted into the supply and demand for basic need items (e.g. food, clothing, housing and education) in the so-called account of want. The conversion of consumption into the account of want in the 1970 SAM may reflect a policy interest on the issue of household basic needs during the 1970s and 1980s as emphasized in literature (see, for example, Perkins, 1978 for China; Kouwenaar, 1988 for Ecuador).

The second difference is both SAMs imply two different production technology assumptions, which reflect two different input-output tables. The 2000 SAM applies a symmetric input-output table, which leads to the assumption that each industry produces only one commodity and each commodity is produced by only a single industry. In that case, no distinction between commodity and activity is made. The 1970 SAM, on the other hand, uses make-use tables introduced by the United Nations in the 1968 System of National Accounts (SNA), extended upon the symmetric table by allowing industries to produce more than one commodity.

Another tricky aspect when dealing with the former SAM is that data for 1970 are not entirely comparable, nor are they uniformly uncompleted. Due to lack of data, income disaggregation of ethnic groups for 1970 period was only possible for the west Malaysia but not for the east Malaysia. In 1970, the west Malaysia represented the largest income share in Malaysia approximately 84%. For the purpose of comparison, we distribute proportionately the income of east Malaysia by assuming composition of ethnic groups across locations is similar to that of west Malaysia[4]. The similar approach is applied for the case of labor. Differences also exist in terms of classifications and definition of production sectors, factors of production and households.

For a consistency purpose, the 1970 SAM has to be reconciled and reclassified by following closely the design and classification of the 2000 SAM, making all the matrices comparable. As a result of reconciliation, a new schematic of 1970 SAM that is consistent with the 2000 SAM is given in Table 2. The adjusted version of 1970 SAM consists of 48 accounts: 17 production activities, 18 factors of production (16 labors—4 ethnic groups × 2 skills × 2 geographical locations, and 2 capitals), 8

[4] Data for non-citizen household in 1970 were not available. Thus, for a consistency analysis, we have left out non-citizen household from our 2000 dataset.

household groups (4 ethnic groups × 2 geographical locations) and an aggregate account for company, government, consolidated capital, current and capital for the rest of the world and indirect tax.

<Insert Table 2>

3.2 *SAM in Constant Price: from Deflating to Balancing*

In order to reveal the real changes in the variables, the 1970 SAM has to be expressed in 2000 constant prices through deflation procedures, making all the matrices comparable. For this purpose, we use the available price indexes, including the producer price index (PPI), import price index (IPI) and implicit price deflator (IPD) by value added and by type of GDP expenditures. All of the price indexes are supplied by the DOS (2004, 2006). Those price indexes may not fully representative to deflate various economic actors in a large dataset such a SAM. This requires alternative deflation procedures, which will be described shortly.

The PPI are mainly used for deflating the production commodities irrespective intermediate demand ($T_{1,1}$) and final demands ($T_{1,3}$ to $T_{1,7}$). The IPI is applied to deflate the competitive import ($T_{7,1}$). To some extent, transactions are altered by using the same price indices because the price indexes only available at aggregate levels.

Sectoral IPD by value added are available but, they may not be able to provide a consistent outcome. We observe that estimated value added in constant price ($T_{2,1}$) by using the IPD by value added are inconsistent with those deflated from the demand perspective by the IPD by type of GDP expenditures. The discrepancies between these two procedures imply that supply is not internally consistent with demand. Since we do not know the 'true' constant value added for the 1970 period and which procedures should be applied, we estimate it residually as similar to the double deflation method.

In our SAM, sectoral value added ($T_{2,1}$) is disaggregated into several classifications of household income ($T_{3,2}$), whereas the estimated value added in constant prices are in an aggregate form. Obviously, the household income can be altered by wage rates and then the corporate business profits ($T_{4,2}$) is obtained residually. Given lack of data on the wage rates, we simply distribute the constant sectoral value added proportionally to all categories of value added.

Two alternative approaches are proposed to overcome the problem of unavailability of price indexes for the rest of transactions in the SAM. First, transactions such as $T_{2,7}$, $T_{9,1}$ and $T_{7,2}$ can be estimated residually from accounting constraint, that is, the total income (row) of any given account be equal to the expenditure (column) of the corresponding account. The total incomes (expenditures) in constant price for the corresponding accounts can be derived using the IPD by types of GDP expenditures. This procedure is only applicable when one transaction in a row or column is unknown.

For the cases that involve many unknown transactions, we secondly estimate them endogenously by using a RAS adjustment, given the total incomes and expenditures in constant prices are known.

Perturbations of the SAM which imposed by the different price indexes may lead to an unbalanced SAM, i.e., incomes do not equal expenditures for almost the entire accounts. This constraint may not exist in input-output deflation using double deflation method because sectoral value added reacts as a balancing item between the deflated gross output, and intermediate domestic and imported inputs[5]. Nevertheless, SAM is a special case as it is a square matrix whose corresponding rows and columns of the accounts must be equal, consistent with the conventional of double-entry accounting principal.

There are several balancing techniques which are available and predominantly used, such as RAS and cross entropy, which can be applied to balance the SAM (see, for example, Thissen and Löfgren, 1998; Robinson, et al., 2001). But, each technique is expected to produce a different outcome. Of course, we can compare superiority of each technique only if we have the 'true' SAM in constant prices. Nevertheless, the 'true' SAM in constant prices is generally unwelcome under this situation.

For the purpose of consistency, we use RAS as balancing technique. Moreover, this technique is more flexible to incorporate some additional or prior information on price indexes or constant values that might be available during the deflation processes, which in turn improves the accuracy of the SAM. It is therefore, RAS is applied for two purposes, estimating of some SAM accounts which do not have individual price indexes and balancing the entire SAM.

4. Structural Decomposition Analysis

A number of studies applies a concept of decomposition analysis within a context of a SAM, but attempts have been made to breakdown the wide-income multiplier effects—which is an endogenous component of the model, for one point in time (see Thorbecke and Jung, 1996 for multiplicative decomposition; Pyatt and Round, 1979 for additive decomposition; Defourney and Thorbecke, 1984 for structural path analysis). Recently, Llop (2007) analyses the causes for the changes in an endogenous component for two SAMs in different points in time. The fact is that the study may not be able to explain the complete causes for the income changes because the analysis limits only on the changes within the endogenous component. This study, therefore, attempts to fulfil this gap by disentangling the changes in income into the changes in its detailed endogenous and exogenous constituent parts.

[5] Dietzenbacher and Hoen (1998) show that given additional information on sectoral value added in constant prices, RAS performed better than double deflation in estimating intermediate deliveries.

Let us start with a standard SAM model which endogenous and exogenous accounts are distinguished. Denoting **y** as a vector of endogenous incomes, **A** as the square matrix containing average expenditure propensities and **z** as a vector of exogenous components, a standard representation of SAM model can be expressed as below

$$\mathbf{y} = \mathbf{A}\mathbf{y} + \mathbf{z} \quad (1)$$

Conventionally, production, $\mathbf{y}_p$, factor of production, $\mathbf{y}_f$ and institution (household and company) $\mathbf{y}_h$, are considered as the endogenous components in the SAM model[6]. Following definition of Table 2, (1) can be partitioned as follows:

$$\begin{bmatrix} \mathbf{y}_p \\ \mathbf{y}_f \\ \mathbf{y}_h \end{bmatrix} = \begin{bmatrix} \mathbf{A}_a & 0 & \mathbf{A}_c \\ \mathbf{A}_v & 0 & 0 \\ 0 & \mathbf{A}_w & \mathbf{A}_t \end{bmatrix} \begin{bmatrix} \mathbf{y}_p \\ \mathbf{y}_f \\ \mathbf{y}_h \end{bmatrix} + \begin{bmatrix} \mathbf{z}_p \\ \mathbf{z}_f \\ \mathbf{z}_h \end{bmatrix} \quad (2)$$

where $\mathbf{A}_a$ represents intermediate input coefficients (input-output linkages), $\mathbf{A}_v$ contains value added (factor) coefficients, $\mathbf{A}_w$ indicates the coefficients of institution income[7], $\mathbf{A}_c$ denotes the coefficients of consumption and $\mathbf{A}_t$ represents the coefficients of distributed profits. Vector of exogenous components (**z**) is partitioned into sectoral final demands ($\mathbf{z}_p$)—comprising government consumption (**g**), investment (**s**) and export (**e**), factor income transfer from abroad ($\mathbf{z}_f$) and institutional transfer from domestic and abroad ($\mathbf{z}_h$).

Based on the definition of (2), the standard representation of the SAM model can be further simplified as:

$$\mathbf{y} = \mathbf{A}\mathbf{y} + (\mathbf{z}_f + \mathbf{z}_g + \mathbf{z}_s + \mathbf{z}_e + \mathbf{z}_h) \quad (3)$$

Equation (3) can be solved and transformed into matrix notations as (4):

$$\mathbf{y} = (\mathbf{I} - \mathbf{A})^{-1} (\mathbf{z}_g + \mathbf{z}_s + \mathbf{z}_e + \mathbf{z}_f + \mathbf{z}_h) \quad (4)$$

Further denoting **M** as the SAM inverse matrix, $(\mathbf{I} - \mathbf{A})^{-1}$ and **z** as the vector of exogenous components $(\mathbf{z}_g + \mathbf{z}_s + \mathbf{z}_e + \mathbf{z}_f + \mathbf{z}_h)$, (4) can be simplified as:

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[6] The choice regarding the subdivision into endogenous and exogenous accounts can be a lengthy discussion on logic and operational in the planning analysis. For a useful comment, see Pyatt (2001).

[7] In SAM modelling, household and company are usually known as an institution. For mathematical presentation, they are combined in a set of account but for our decomposition analysis, we run these two accounts separately.

$$\mathbf{y} = \mathbf{Mz} \quad (5)$$

According to (5), income of endogenous accounts can be obtained by simply post-multiplying SAM inverse matrix, **M**, with the vector of exogenous, **z**. When two SAMs for different points in time are available, the decomposition of income changes over the periods can be calculated as the first difference of (5):

$$\Delta\mathbf{y} = \mathbf{y}_1 - \mathbf{y}_0 \quad (6)$$

$$\Delta\mathbf{y} = \mathbf{M}_1\mathbf{z}_1 - \mathbf{M}_0\mathbf{z}_0 \quad (7)$$

$$= \mathbf{M}_0(\mathbf{z}_1 - \mathbf{z}_0) + (\mathbf{M}_1 - \mathbf{M}_0)\mathbf{z}_1 = \mathbf{M}_0(\Delta\mathbf{z}) + (\Delta\mathbf{M})\mathbf{z}_1 \quad (8)$$

or similarly

$$= \mathbf{M}_1(\mathbf{z}_1 - \mathbf{z}_0) + (\mathbf{M}_1 - \mathbf{M}_0)\mathbf{z}_0 = \mathbf{M}_1(\Delta\mathbf{z}) + (\Delta\mathbf{M})\mathbf{z}_0 \quad (9)$$

Accordingly, change in income between base year (0) and terminal year (1) can be decomposed into the effects that are determined by the changes in endogenous components (**ΔM**) and exogenous components (**Δz**).

The issue of non-uniqueness of structural decomposition forms has received considerable attention because the numerical results can vary subject to the index number problem. For example, (8) and (9) are basically identical to each other, but they could produce different outcomes because different weighted years are used. Dietzenbacher and Los (1998)[8] however, show that the average of polar decompositions, which can be viewed as the extension of the Laspeyres and Paasche forms when more than two determinants exist, is a very good approximation of the average of all the potential decompositions that exist (Liu and Saal, 2001). Hence,

$$\Delta\mathbf{y} = \tfrac{1}{2}(\mathbf{M}_0 + \mathbf{M}_1)(\Delta\mathbf{z}) + \tfrac{1}{2}(\Delta\mathbf{M})(\mathbf{z}_0 + \mathbf{z}_1) \quad (10)$$

The change in the SAM inverse **M**, in terms of the change in the average expenditure propensities of matrix **A**, can be derived as follows:

[8] See Oosterhaven and van der Linden (1997) for a first application of the average polar decomposition. Recently, de Boer (2008) proposed use of the Montgomery decomposition as an alternative approach to the polar and elementary decompositions. The findings however, show that the Montgomery and Polar approaches yield results that are close to each other.

$\Delta\mathbf{M} = \mathbf{M}_1 - \mathbf{M}_0 = \mathbf{M}_1[(\mathbf{I} - \mathbf{A}_0) - (\mathbf{I} - \mathbf{A}_1)]\mathbf{M}_0 = \mathbf{M}_1(\mathbf{A}_1 - \mathbf{A}_0)\mathbf{M}_0$. Similarly, $\Delta\mathbf{M} = \mathbf{M}_0(\mathbf{A}_1 - \mathbf{A}_0)\mathbf{M}_1$. Therefore,

$$\Delta\mathbf{M} = \mathbf{M}_1(\Delta\mathbf{A})\mathbf{M}_0 = \mathbf{M}_0(\Delta\mathbf{A})\mathbf{M}_1 \quad (11)$$

Substituting (11) into the second term of (10), we obtain the following expression:

$$\tfrac{1}{2}(\Delta\mathbf{M})(\mathbf{z}_0 + \mathbf{z}_1) = \tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A})\mathbf{M}_0\mathbf{z}_0 + \mathbf{M}_0(\Delta\mathbf{A})\mathbf{M}_1\mathbf{z}_1] = \tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A})\mathbf{y}_0 + \mathbf{M}_0(\Delta\mathbf{A})\mathbf{y}_1] \quad (12)$$

Combining all elements in equations (12) and (10), we achieve the complete decomposition forms of income changes:

$$\Delta\mathbf{y} = \tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A})\mathbf{y}_0 + \mathbf{M}_0(\Delta\mathbf{A})\mathbf{y}_1] + \quad (13a)$$
$$\tfrac{1}{2}(\mathbf{M}_0 + \mathbf{M}_1)(\Delta\mathbf{z}_g) + \quad (13b)$$
$$\tfrac{1}{2}(\mathbf{M}_0 + \mathbf{M}_1)(\Delta\mathbf{z}_s) + \quad (13c)$$
$$\tfrac{1}{2}(\mathbf{M}_0 + \mathbf{M}_1)(\Delta\mathbf{z}_e) + \quad (13d)$$
$$\tfrac{1}{2}(\mathbf{M}_0 + \mathbf{M}_1)(\Delta\mathbf{z}_f) + \quad (13e)$$
$$\tfrac{1}{2}(\mathbf{M}_0 + \mathbf{M}_1)(\Delta\mathbf{z}_h) + \quad (13f)$$

According to (13), changes in income of the endogenous accounts can be decomposed into the effects that are determined by changes in: (13a) average expenditure propensities; (13b) government consumption; (13c) investment; (13d) exports; (13e) factorial transfer from abroad; and (13f) institutional transfer.

Notice that matrix $\mathbf{A}$ contains several structural relationships ($\mathbf{A} = \mathbf{A}_a + \mathbf{A}_v + \mathbf{A}_w + \mathbf{A}_c + \mathbf{A}_t$), which allow us further to decompose changes in the average expenditure propensities into its constituent parts, hence showing the inter-dependencies effect among endogenous accounts. Thus, equation (13a) can be further decomposed as:

$$\Delta\mathbf{M} = \tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A}_a)\mathbf{y}_0 + \mathbf{M}_0(\Delta\mathbf{A}_a)\mathbf{y}_1] + \quad (14a)$$
$$\tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A}_v)\mathbf{y}_0 + \mathbf{M}_0(\Delta\mathbf{A}_v)\mathbf{y}_1] + \quad (14b)$$
$$\tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A}_w)\mathbf{y}_0 + \mathbf{M}_0(\Delta\mathbf{A}_w)\mathbf{y}_1] + \quad (14c)$$
$$\tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A}_c)\mathbf{y}_0 + \mathbf{M}_0(\Delta\mathbf{A}_c)\mathbf{y}_1] + \quad (14d)$$
$$\tfrac{1}{2}[\mathbf{M}_1(\Delta\mathbf{A}_t)\mathbf{y}_0 + \mathbf{M}_0(\Delta\mathbf{A}_t)\mathbf{y}_1] + \quad (14e)$$

Equation (14) breaks down the changes in the average expenditure propensities into the effects of: (14a) technological change in intermediate inputs, (14b) technological change in labor and capital,

(14c) changes in wages, (14c) changes in consumption and (14e) changes in distributed profit. Combining (13) and (14), we now decompose changes in income into 10 separate forms. Notice that each the 10 decomposition forms yields a 3*n*-element of vector. The first *n* element gives the effects on sectoral output, the second *n* element reveals the effects on the factor income and the last *n* element provides the effects on institution income.

In addition to the income, our decomposition framework can be further extended to capture changes in employment (**ΔE**) due to the changes in endogenous and exogenous components. In turn, we are in fact able to analyse the contribution of endogenous and exogenous components to the inequality. Decomposition of employment changes can be summarised as follow

$$\mathbf{\Delta E} = \tfrac{1}{2}(\mathbf{\Delta L})(\mathbf{y}_0 + \mathbf{y}_1) + \quad (15a)$$

$$\tfrac{1}{4}(\mathbf{L}_0 + \mathbf{L}_1)[\mathbf{M}_1(\mathbf{\Delta A})\mathbf{y}_0 + \mathbf{M}_0(\mathbf{\Delta A})\mathbf{y}_1] + \quad (15b)$$

$$\tfrac{1}{4}(\mathbf{L}_0 + \mathbf{L}_1)(\mathbf{M}_0 + \mathbf{M}_1)(\mathbf{\Delta z}_g) + \quad (15c)$$

$$\tfrac{1}{4}(\mathbf{L}_0 + \mathbf{L}_1)(\mathbf{M}_0 + \mathbf{M}_1)(\mathbf{\Delta z}_s) + \quad (15d)$$

$$\tfrac{1}{4}(\mathbf{L}_0 + \mathbf{L}_1)(\mathbf{M}_0 + \mathbf{M}_1)(\mathbf{\Delta z}_e) + \quad (15e)$$

$$\tfrac{1}{4}(\mathbf{L}_0 + \mathbf{L}_1)(\mathbf{M}_0 + \mathbf{M}_1)(\mathbf{\Delta z}_f) + \quad (15f)$$

$$\tfrac{1}{4}(\mathbf{L}_0 + \mathbf{L}_1)(\mathbf{M}_0 + \mathbf{M}_1)(\mathbf{\Delta z}_e) + \quad (15g)$$

where **L** denotes labor coefficients (labor per unit of output). The interpretation of the last six expressions remains the same as (13), while (16a) indicates the effects of changes in labor per unit of output.

The above frameworks show that decomposition analyses within a SAM captures the complete circular flow of incomes by integrating not only the inter-industry effects, but also the relations between factor-income distribution, consumption and re-distribution effects. In turn, the underlying causes for the changes in income can be measured comprehensively through a wide-decomposition analysis. Decomposition of income changes also can be analysed by using an input- output model, in particular a semi-closed input-output model. The semi-closed input-output captures interdependency relationships between production and household components as it partially endogenizes component of final demand (consumption) and primary input (labor income). However, to some extent, the model may not fully integrate and explain the full generation of income in the economy, due to the limitation of data provided in the input-output tables.

5. Results and Discussion

For reasons of exposition, we decide to detail only decomposition results of income changes for household and labor, which consistent with our aim[9]. Decomposition results at detailed production sectors and company are available in Appendix A. Results are discussed in three sub-sections. We firstly, identify the main determinants of income changes and later further discuss how these determinants affect differently income of individual ethnic groups. Then, we offer an explanation that can be put forward to justify the causes for the income variation among ethnic groups. Finally, we discuss the extent to which the determinants contribute to the changes in income inequality by taking into account both distribution effects on income and employment. It should be stressed that inequality among Malay, Chinese and Indian are large and for this reason, emphasized will be given on explaining sources of income growth among these major ethnic groups.

5.1 Sources of Income Changes

The total income changes and average annual growth rate between 1970 and 2000 for households is given in rows (1) and (2) of Table 3. A remarkable finding is that urban households benefit the most from the structural transformation of the economy. The growth in income is above the average (i.e. 4.98%) for urban households and below the average for rural households, with the ratio is 3.16 (setting rural income at unity). For the changes among the major ethnic groups, we observe that income changes is the highest for the Malay, the lowest for the Chinese, with the Indian in between, for both rural and urban areas. Setting the income changes of the Malay at unity, the ratios for Chinese and Indian are 0.56 and 0.76 for rural areas, and 0.66 and 0.73 for urban areas.

<Insert Table 3>

Next, we decompose the income changes in order to identify the main components that driven to the changes and explain how these components contribute differently across ethnic groups. For the time being, we only discuss the sources of income changes for each ethnic group and reserve the issue of income distribution into the Section 5.3. In rows (3) to (12) of Table 3, the total income changes, i.e. row (1), are decomposed into the effects that determined by each component. We express the contribution of each component as percentage points of total income changes. For rural Malay, change in intermediate inputs explains 20% of income changes, which this equivalent to 3.3 billion MR. The sum over the 10 components (rows (3) to (12)) equals to 100%. A component is considered as a dominant source if its contribution to the income changes is the largest among the components.

[9] For income distribution analysis, a link between household and labor is necessary. This is because changes in labor income may have large effects on household income given the fact that it contributes about 58% of household income.

Two components—expansion in exports and technological change in labour and capital inputs—are the most important determinants for the changes in household income. The contributions of these components vary largely across geographical locations and ethnic groups. For the contribution of exports growth, rural households (except for the group of other minority ethnics) registered above the average income changes as indicated in the last column of the table, whereas urban households (except for Chinese) experienced below the average. Setting the rural income changes at unity, the ratios for urban incomes are range from 0.28 for Malay, via 0.30 for Chinese, to 0.41 for Indian. Among the major ethnic groups, exports promote a relatively smaller effect to the Malay compared to the Chinese and Indian, which the differences are large in urban areas. The ratios for urban areas are deviated 2.89 for Chinese and 1.90 for Indian, compared to 2.66 for Chinese and 1.29 for Indian in rural areas (setting income changes of Malay at unity).

For contribution of changes in labour and capital, the outcomes are contrast to the exports. This component has reduced income for almost all households, which the reduction appears to be largely attributed to the rural households. The ratios for rural households are 9.47 for Malay, 4.20 for Chinese and 3.07 for Indian (setting the income changes of urban households at unity). Detail the results across ethnic groups shows that the contribution of this component is very similar as the effects of exports. That is, Malay is the least affected group both in rural and urban areas. Ratios for the changes in income for the Malay over Chinese and Indian are 0.32 and 0.62 for rural areas, and 0.14 and 0.20 for urban areas. These unique outcomes may lead to the question of why Malay is the less affected from the changes in labour and capital (as well as exports). We will answer this question in the next sub-section.

For the rest of the determinants, we attempt to do not further detail their contributions on income changes because neither they are less variance across ethnic groups nor they only contribute small income effects. For example, although expansions in government and investment explain averagely by 28% and 26% of income changes, they do not show a large variation across ethnic groups. The rest of components show a small effects on income changes, which contributes only in total by 7%.

Table 4 presents changes in labor income and contribution by each component to the changes. We observe in column (1) that the distribution of labor income across locations and ethnic groups shows a large similarity with the distribution of household income. The ratio for urban income is 3.24 (setting rural income at unity). Among rural households, the ratios for Chinese and Indian are 0.31 and 0.10, and that of urban households, the ratios are 0.96 and 0.21 (setting labour income of the Malay at unity).

<Insert Table 4>

Detail the results across skills, the explanation for the above outcomes is the shifting in employment intensities from unskilled to in favour skilled labors. Changes in the pattern of employment requirements may reflect a significant shifting in the production technologies from traditional (essentially labor-intensive) to modern (essentially capital-intensive) activities which in turn, generate labor substitutions between unskilled and skilled. Since modern economic activities are mostly concentrated in urban areas, urban skilled labors are the most benefit from the structural change in production techniques. This can be justified on the basis of results in column (1) of Table 4. For urban households, income of unskilled labor grows lower than the skilled one and for rural households, it has been declined negatively. Among the skilled labors, income of urban households has increased higher than rural households at the ratios 1.86 for Malay, 5.82 for Chinese and 3.92 for Indian (setting rural skilled income at unity).

Changes in labour and capital account for the most of reduction in unskilled income. For rural households, although exports and other components contribute positive effects, they may not enough to compensate the negative effects of changes in labour and capital. For urban households, the reduction of unskilled income has been offset largely by the increase in exports of labor-intensive commodities. However, increase in the exports of labor-intensive commodities might not be larger as exports of capital-intensive commodities. We observe that expansion in capital-intensive commodities has offset the negative effects of changes in labour and capital for the skilled income of Chinese and Indian. The joint effects between changes in exports, and labor and capital are 29% and 28% for the Chinese and Indian in rural areas, and 59% and 43% for the Chinese and Indian in urban areas. For the Malay skilled, changes in labor and capital, and exports contribute positively but at moderate effects, the explanations for which will be discussed in the next sub-section.

It is a necessary to discuss briefly decomposition results at production sectors, so as we can identify the sources of changes in exports, and labor and capital inputs. For this purpose, we will focus our attention on output changes in non-services sectors and among the non-services sectors; we might broadly classify the sectors into resource-based and non-resource-based activities[10]. For the export growth, we observe that exports of non-resource-based products, in particularly machinery and vehicles, are found to be the major contributor. If we express a percentage ratio of the changes in exports of non-resource-based (364.1 billion MR) over the total changes in exports of non-services

[10] Changes in output of services sectors are limited, which explains only about one-third of the changes in total output. We define machinery and vehicles, and other manufacturing sectors as the non-resource-based activities and the rest of other non-services sectors as the resource-based activities. Due to aggregation problem, we are unable to distinguish resource-based and non resource-based activities into specific sectors.

sectors (612.9 billion MR), this would be equal to 60% (which machinery and vehicles alone contributes about 42%). In contrast to the exports, reduction in labor and capital requirements appears to be influenced largely by the resource-based activities. Expressing the ratio of these sectors over the total of non-services sectors, it follows that these sectors explain 73% of the reductions. Among the sectors, food, beverages and tobacco, agricultural products and meat dairy explain the most for the reductions.

There are two main implications emerge from these outcomes. First, production of non-resource based sectors is labor-intensive activities which may utilize a large number of unskilled labors. The fact is that during the economic transformation, these sectors receive a large foreign technological transfers rather than technological upgrading. This can be justified for example, for the case of electric and electronic products, which Japanese-owned firms are the major players. Wakasugi (1994) shows that new technological innovations took place vigorously in the Japanese electrical machinery sector, and old technologies were transferred gradually to developing countries through foreign direct investment. Since old technologies usually are labor-intensive, this would lead to the utilization of a large number worker especially those unskilled.

Second, our results might be limited, but to some extent, could support the theoretical expectation that trade growth has been associated by a reduction of demand for unskilled labor (see, for instance, Conte and Vivarelli, 2007; Ochsen and Welsch, 2005). This can be justified for the case of resource-based sectors. We observe that expansion in exports contribute mostly to the output growth of agriculture, meat and dairy, and food, drink and tobacco but equally important these sectors also indicate among the largest reduction in labor input relative to other sectors, as explained by the change in labour and capital.

5.2 A Reason for the Variation in Income Changes

We have shown in the previous sub-section that changes in exports, and labor and capital have different effects on income changes across ethnic groups. The joint effects of these two determinants may suggest why total income growth of the Malay is higher than the Chinese and Indian, given the contribution of other determinants are less variances. For both determinants, Malay is the less affected group, either in term of positive effect of exports growth or negative effect of changes in labour and capital.

We further analyze to explain the reason behind the lower income effects that attributed to the Malay. For this purpose, we compile and analyze labor structures between 1970 and 2000 (see Appendix B). A remarkable finding based on our dataset is that Malay workers are mostly employed in

the public services sectors. The share of Malay workers in the public services sectors (education and health, and other government services) has increased from 15% in 1970 to 22% in 2000. Within the sectors itself, the share of skilled employment has climbed from 25% in 1970 to 90% in 2000, whereas the share of unskilled employment has declined from 75% to 10%. The opposite holds for the Chinese and Indian. The composition of Chinese and Indian workers in the public services sectors not only show a small share but also had been reduced—8% to 6% for the Chinese and 17% to 12% for the Indian. Concentration of a large employment in the public services sectors can be put forward as an explanation for the pattern of changes in Malay income. For example, employment shifts in favour skilled labour may explain the positive income changes for the Malay skilled—25% for rural and 29% for urban due to the changes in labour and capital inputs, as indicated in Table 3.

Notice that output growth in the public service sectors does not grow as fast as other sectors because these sectors are considerably as "supplementary sectors" which not based on export orientation and have low technological innovations. In turn, the dominant employment in these sectors might not gain from the structural changes in the economy. That is the reason why our results show that changes in exports, and labor and capital contribute relatively low income effects to the Malay than the Chinese and Indian. However, employment in the public service sectors may gain from the effects of the expansion in government consumption as this expenditure mostly directed towards their own sectors. Therefore, we observe the contribution of this expenditure to the changes in income for the Malay is comparable among the Chinese and Indian (see Table 3).

Although the total income of the Malay has increased more than the Chinese and Indian, from a planning point of view, it is not a sustainable income growth. While income growth of the Malay is "public-driven", that of the Chinese and Indian is "market-driven". As a consequence of this, Malay cannot gain as much as other ethnic groups because structural changes in public services sectors are limited. These labor segmentations may be formed as a result of certain exogenous forces which erected direct and indirect barriers between ethnic groups in the labor force and prevented the long-run equalizing tendencies of the market place to occur over time. This caused mobility of employment between these segments of the labor force to be so limited that wage differences could remain over long stretches of time.

5.3 Sources of Changes in Inequality

So far, we have discussed the sources of income changes for the individual household groups without explicitly linking it into the issue of income distribution. This section further examines the size of income effects that have been distributed across ethnic groups by each component. This is given in

Panel A of Table 5. We express the distributional effects from each component by simply taking percentage share of income change over the total change in components. For example, changes in intermediate inputs contribute 7 billion MR to the total income changes and of this, 7% are distributed to the rural Malay, 2% to rural Chinese, 3% to rural Indian and so on. The sum over the nine ethnic groups equals to 100%. The similar procedures are applied for the calculation of distributional effects on the changes in employment, as indicated in Panel B.

<Insert Table 5>

Two important aspects about Table 5 should be kept in mind while discussing the findings. First, we refer distribution of labor income instead of household income. Household income is analyzed in complement with population but, population change may not be able to integrate in the model due to some constraints and the manner in which the model has been developed. This is only possible for the employment changes. Second, employment data for 1970 at disaggregated level were lacking, so to reduce computation errors we choose to aggregate the labor.

A remarkable finding suggests in Panel A is that the distribution effects of the components vary largely across locations and ethnic groups with a constant pattern. Effects of changes in components have distributed mostly to the income share of urban households than rural households. Setting income share of rural households at unity, the ratios for urban households are range from 0.89 for changes in wages to 8.03 for changes in intermediate inputs. For the distribution among major ethnic groups, changes in components contribute mostly to the income change of the Malay in the rural areas, whereas in the urban areas, the changes promote mainly to the Chinese. The Indian takes the intermediate position. The only exceptional is that the Malay gains the income effects from the changes in government consumption for both rural and urban areas. As explained previously, a large number of the Malay is employed in the public services sectors which results they may benefit mostly from the expansion in government consumption.

For the distribution effects on employment, the outcomes are slightly different. As indicated in Panel B, almost all components contribute more to the employment share of rural households; with the ratios for urban households are ranges from 0.32 for changes in wages to 0.93 for changes in investment (setting income share of rural households at unity). For the changes in intermediate inputs and consumption, urban households account for the largest employment share. For the distribution among major ethnic groups, the similar outcomes remain as for the changes in income. Combining outcomes in Panel A and B provides an indication that changes in economic structures although impressive, have limited effects in shifting composition of dualistic economic activities. The dualities indicate that large rural economic activities (essentially agricultural) are engaged by the Malay,

whereas modern economic activities (essentially industrial) are employed by the Chinese. These dualities seem to be deeply permeated in the whole fragment of these ethnic groups.

In addition to the relative distribution effects, sizes of distribution effects between changes in income and employment may reveal some interesting outcomes in term of inequality. In Panel C, we calculate inequality index for total income changes and for the specific income changes by components. Based on available dataset at an aggregated level, a single measure of inequality between household groups is calculated by applying the Theil index of inequality (T_b). The inequality is derived by taking into account both changes in income share (Panel A) and that of employment share (Panel B).

Notice that the occurrence of negative values in our decomposition analysis implies that the original Theil formula has to be modified. The reason is that Theil index contains logarithmic terms and one of the variables (either income or employment) cannot have negative values. To overcome this constraint, we apply a small value (SV) strategy, which attempts mainly to tackle a zero-value problem in the logarithmic mean divisia index (LMDI, see for example, Ang and Liu, 2007a; Ang and Liu, 2007b; Wu et al., 2006; Ang, 2005). Technical details of the derivation of T_b index and the treatment of the logarithm negative values can be referred to in Appendix C.

Each column Panel C indicates the contribution of each household group to the T_b with the last column indicates a total index of inequality. Using an entropy concept, T_b can be interpreted as the expected information of a message that transforms employment shares into income shares (Theil, 1967). When there is a perfect equality, income shares (y_i) and employment shares (n_i) of each household group are equal, and T_b value would be zero. If the income shares are lower (higher) than that of employment shares, the T_b value would be negative (positive). A similar interpretation can be applied for the case of measuring inequality for changes in income and employment. In our study, changes in components are equally distributed if changes in income shares (Δy_i) are equal to changes in employment (Δn_i) for all ethnic groups.

Inequality is expressed in two indexes as shown in rows (22) and (23). Row (22) is estimated based on distribution of changes in income in row (24) and of changes in employment in rows (25). Distribution of row (24) is obtained as a weighted average of income changes in rows (1) to (10) and that of row (25) is a weighted average of rows (12) to (21). We define this inequality as a structural-inequality because it captures the employment effects that contributed only by the components. In row (23), we express the inequality that contributed by all the effects on employment changes and define it as overall-inequality. It is estimated based on distribution of rows (24) and (26)—employment changes that explained in rows (11) to (21).

Let us first discuss results in row (22). The main outcome here is that changes in income and employment contribute to a positive inequality at high scale. The index for total inequality is 0.260, which indicates that income has increased larger than that of employment by 26%. The positive inequality is mainly contributed by urban households whereas rural households explain negatively. The indexes for the urban and rural households are 0.348 and -0.087. There is a tendency for the improvement in inequality among ethnic groups because the components promote more income growth to the Malay than other groups. The joint inequality effects between rural and urban areas are 0.276 for the Malay, and -0.073 and -0.007 for the Chinese and Indian.

In rows (27) to (36), we decompose inequality in (22) by each individual component. These results will provide explanations for the observed inequality for all ethnics as in (22). The contribution of the components to the inequality is somewhat vary, which distribution effects of change in government consumption is the most egalitarian and that of change in consumption is the most unequal one. For the discussion, we however, focus our attention only on the top 5 components, i.e. changes in— intermediate inputs, labour and capital, government consumption, investment and exports. The reason is that the rest of the components constitute only less than -2% of the total changes (-2% for income and -1% for employment), which implies that the differences have little effects on total inequality.

Among the components, contribution of the changes in labor and capital is considered as an important determinant in pulling-down the inequality. For urban households, changes in intermediate inputs, government consumption, investment and exports contribute positive effects at 0.277, 0.196, 0.130 and 0.234 whereas changes in labor and capital inputs explain negative effects at -0.467. The joint effects for all these components indicates that changes in labour and capital inputs react as a pulling-down factor and if not the inequality is likely to increase higher than the current level. Detail the results across ethnic groups, the similar component explains for the inequality between the Malay and Chinese. Observed that inequality for the Chinese for the changes in intermediate inputs, investment and exports is higher than the Malay at the ratios of 3.29, 4.30 and 4.64 (setting inequality Malay at unity). The fact is that changes in labor and capital contribute negatively to Chinese and positively to Malay. The joint of these two effects explain for the positive inequality of the Malay and for the negative inequality of the Chinese (see row (22)). For the Indian, the inequality can be explained by the positive effects of changes in intermediate inputs.

The similar reasoning as urban households can be used for the explanation of rural households. For rural households, the first four mentioned components contribute negative inequality effects at -0.128, -0.134, -0.201 and -0.137 whereas changes in labour and capital explain positively at 0.128. Jointly, rural inequality is decreased to a lesser extent. The Malay benefits for the changes in labour and capital,

which this component may pull-down the negative effects of other four components. For the Chinese and Indian, explanation for the negative inequality as indicated in row (22) is straightforward. It can be observed that all of the five components contribute negatively to their inequality.

Next, we compare results in row (22) and (23). Both inequality measures show positive effects but, inequality that explained by all effects on employment (as in 23)) is "extremely" low with the index for total inequality is 0.057. The indexes for the urban households decline more than triple to 0.111 and for rural households reduce about double to -0.055. These outcomes are formed as a result of shifting in inequality among ethnic groups. For rural households, inequality for the Malay is remain unchanged as it was in row (22) but inequality for Chinese and Indian has been decreased from -0.061 to 0.029 and from -0.014 to 0.002. The opposite holds for urban households. Inequality for the Malay has declined from 0.328 to 0.027 and that of Chinese and Indian has climbed from -0.012 to 0.084 and from 0.007 to 0.012.

Combining all the effects provides a clear indication that condition of rural households is generally worse than urban households, and that among rural households, the Malay is the looser, whereas the Chinese is the gainer among the urban households. The explanation for these outcomes are changes in labor coefficient (row (11)), which indicate a variation in labor productivity. The overall-inequality is registered at 0.057 compared to 0.260 of the structural-inequality, which the reduction is completely because of the increase in labor productivity. Measured in total output per worker, the average Malaysia's productivity increased from 32 thousand MR per worker in 1970 to 101 thousand MR per worker in 2000. All things being equal, this increase would lead to the reduction in employment by 14.40 thousand (see Appendix D). However, it was offset somewhat by the employment-driven effect of changes in—labor and capital, consumption, government consumption, investment, exports, factor transfer and institutional transfer, which sum of these contribute to increase in employment by 25.02 thousand.

The increase in labor productivity is equally contributed by the reduction of rural and urban employments at 7.26 million and 7.14 million. Among the ethnic groups, productivity differential is smaller in rural than urban areas. For rural households, the productivity difference is 1.22 for Chinese and 0.24 for Indian (setting Malay employment reduction at unity). For urban households, the ratios are 8.11 for Chinese and 1.52 for Indian. The explanation for the lower productivity for the Malay is that most of them are employed in the government services sectors which considered as low productivity sectors. The deviation between average productivity of the government and private sectors are 1.66 for 1970 and 4.07 for 2000 (setting average productivity of the government sectors at unity). All in all, this

would explain the outcomes in row (23), i.e. the higher productivity of Chinese and Indian leads to the higher income growth.

6. Concluding Remarks

This paper examines the sources of income growth for all ethnic groups in Malaysia over the period 1970-2000. It employs a decomposition framework that separates out the income growth into the effects that determined by the detailed endogenous and exogenous components of income. Expansion in exports and technological change in using labor and capital inputs are the main causes for the income growth for all ethnic groups. However, these two components (and other components as well) have limited effects on the growth and distribution of income for the Malay compared to the Chinese and Indian.

Analyzing the employment structure indicates that allocational aspect of employment is matter in explaining the distributive effects of structural change in a developing economy. The substantial change in output is mainly driven by the private sectors but, a large segment of the Malay workers (who averagely the lowest income group) is concentrated in the public services sectors. These would lead to the modest income growth and so moderate reduction in inequality. The reasons are that structural changes in the public services sectors are very limited and these sectors characterized by having lower labor productivity. The main conclusion here is that growth in income of the Malay may not be considered as a sustainable growth because it was largely driven by the public stimulus. For example, when the government liberalized the economy during the period of NDP, we have shown in the early discussion that average income of the Malay getting worse.

Linking these main outcomes to the implemented policies, several lessons which are related to labor policies can be put forward tentatively to explain the distribution outcomes. Firstly, policy reforms for labor market in the NEP provided high privileges to the Malay participation in the government services sectors. As a counter action to this policy, non-Malays may directly or indirectly discriminate the Malay in the private sectors in which government does not have any control on it. Consequently, mobility of employment among sectors is limited. Secondly, industrialisation with capital-intensive tends to reduce the demands of unskilled labour because technological change is biased towards skilled labour. The fact is that the unskilled labors are dominated largely by the Malay, shifting the demand in favor of skilled labor resulted in an increase in wage dispersion and so an increase in the income inequality. Finally, the continuous influx of migrant workers, both legal and illegal from neighbouring countries may deny some local labor force from “fruits” of economic growth

since the late 1980s. The constant inflows of immigrant labor, may continue to add to the pool of unskilled labor so that rapid industrialisation has failed to increase wages for the unskilled labor.

References

Ang, B.W., "The LMDI Approach to Decomposition Analysis: a Practical Guide," *Energy Policy*, 33, 867-71, 2005.

Ang, B.W. and Na. Liu, "Handling Zero Values in the Logarithmic Mean Divisia Index Decomposition Approach," *Energy Policy*, 35, 238-46, 2007a.

Ang, B.W. and Na. Liu, "Negative-value Problems of the Logarithmic Mean Divisia Index Decomposition Approach," *Energy Policy*, 35, 739-42, 2007b.

Athukorala, P-C. and J. Menon, "Outward Orientation and Economic Development in Malaysia," in Hal Hill (eds), *The Economic Development of Southern Asia*, Edward Elgar Publishing Limited, Glos (UK), 2002.

de Boer, P., "Additive Structural Decomposition Analysis and Index Number Theory: an Empirical Application of the Montgomery Decomposition," *Economic System Research*, 20, 97-109, 2008.

Choi, K.H. and B.W. Ang, "A Time-series Analysis of Energy-related Carbon Emissions in Korea," *Energy Policy*, 29(13), 1155-61, 2001.

Choi, K.H. and B.W. Ang, "Measuring Thermal Efficiency Improvement in Power Generation: the Divisia Decomposition Approach," *Energy*, 27, 447-55, 2002.

Conte, A. and M. Vivarelli, "Globalization and Employment: Imported Skill Biased Technological Change in Developing Countries," IZA Discussion Paper No. 2797, IZA, Bonn, 2007.

Cook, P. and Y. Uchida, "Structural Change, Competition and Income Distribution," *The Quarterly Review of Economics and Finance*, 48, 274-86, 2008.

Defourny, J. and E. Thorbecke, "Structural Path Analysis and Multiplier Decomposition within a Social Accounting Matrix Framework," *The Economic Journal*, 94(373), 111-36, 1984.

Department of Statistics, *Annual National Product and Expenditure Accounts, 1987-2003*, Department of Statistics, Putrajaya, 2004.

_____, *Malaysia Economic Statistic –Time Series*, Department of Statistics, Putrajaya, 2006

_____, *Household Income Survey 2000*, unpublished, 2001.

Dietzenbacher, E. and A.R. Hoen, "Deflation of Input-Output Tables from the User's Point of View: a Heuristic Approach," *Review of Income and Wealth*, 44, 111-22, 1998.

_____. and B. Los, "Structural Decomposition Techniques: Sense and Sensitivity," *Economic Systems Research*, 10, 307-23, 1998.

Economic Planning Unit, *Malaysia Plan*, Percetakan Nasional Malaysia Berhad, Kuala Lumpur, various years.

Faaland, J., J. Parkinson, and R. Saniman, *Growth and Ethnic Inequality*, Utusan Publications and Distributions, Kuala Lumpur, 2003.

James, J. and H.A. Khan, "Technology Choice and Income Distribution," *World Development*, 25, 153-65, 1997.

Kijima, Y., "Why did Wage Inequality Increase? Evidence from Urban India, 1983-99," *Journal of Development Economics*, 8, 97-117, 2006.

Kouwenaar, A., *A Basic Needs Policy Model: a General Equilibrium Analysis with Special Reference to Ecuador*, Elsevier Science Publishers, Amsterdam, 1988.

Liu, A. and D.S., Saal, "Structural Change in Apartheid-era South Africa: 1975-93," *Economic System Research*, 13, 235-57, 2001.

Llop, M., "Comparing Multipliers in the Social Accounting Matrix Framework: the Case of Catalonia," *Environment and Planning A*, 39, 2020-29, 2007.

Manasse, P. and A. Turrini, "Trade, Wages and 'Superstars'," *Journal of International Economics*, 54, 97-117, 2001.

Ochsen, C. and H. Welsch, "Technology, Trade and Income Distribution in West Germany: a Factor-share Analysis, 1976-1994," *Journal of Applied Economics*, 8, 321-45, 2005.

Oosterhaven, J. and J.A. van der Linden, "European Technology, Trade and Income Changes for 1975-85: an Intercountry Input-Output Decomposition," *Economic System Research*, 9 (4), 393-411, 1997.

Oosterhaven, J. and A.R. Hoen, "Preferences, Technology, Trade and Real Income Changes in the European Union: an Intercountry Decomposition Analysis for 1975-1985," *The Annals of Regional Science*, 32, 505-24, 1998.

Perkins, D., "Meeting Basic Needs in the People's Republic of China," *World Development*, 6, 561-66, 1978.

Pyatt, G., "Some Early Multiplier Models of the Relationship between Income Distribution and Production Structure," *Economic System Research*, 13, 134-63, 2001.

Pyatt, G. and J.I. Round, "Accounting and Fixed-price Multipliers in a Social Accounting Matrix Framework," *Economic Journal*, 89, 850-73, 1979.

_____, "Improving the Macroeconomic Data Base a SAM for Malaysia, 1970," World Bank Staff Working Paper No. 646, World Bank, Washington, 1984.

Robinson, S., A. Cattaneo, and M. El-Said, "Updating and Estimating a Social Accounting Matrix using Cross Entropy Methods," *Economic System Research*, 13, 47-64, 2001.

Saari, M.Y., E. Dietzenbacher, and B. Los, "The Impact of Growth on Income Distribution among the Malaysian Ethnic Groups: a Social Accounting Matrix Approach," in *16th International Input-Output Conference*, International Input-Output Association, Istanbul, 2007.

Theil, H., *Economics and Information Theory*, North-Holland, Amsterdam, 1967.

Thissen, M. and H. Löfgren, "A New Approach to SAM Updating with an Application to Egypt," *Environment and Planning A*, 30, 1991-2003, 1998.

Thorbecke, E. and H-S. Jung, "A Multiplier Decomposition Method to Analyse Poverty Alleviation," *Journal of Development Economics*, 48, 279-300, 1996.

United Nations, *A System of National Accounts*, United Nations, New York, 1968.

Wakasugi, R., "Is Japanese Foreign Direct Investment a Substitute for International Trade?," *Japan and the World Economy*, 6, 45-52, 1994.

Wu, L., S. Kaneko, and S. Matsuoka, "Dynamics of Energy-related CO_2 Emissions in China during 1980 to 2002: the Relative Importance of Energy Supply-side and Demand-side Effects," *Energy Policy*, 34, 3549-72, 2006.

Zakariah, A.R. and E.E. Ahmad, "Sources of Industrial Growth using the Factor Decomposition Approach: Malaysia, 1978-87," *The Developing Economies*, 37, 162-96, 1999.

Table 1
Growth in GDP and average monthly household income, 1970-00

			Selected periods	
A. GDP growth rates (%)		*1970-1990*	*1990-2000*	*1970-2000*
Agriculture		7.72	4.76	6.90
Mining and quarrying		14.79	9.29	13.29
Manufacturing		14.59	13.11	14.54
Construction		11.47	10.46	11.48
Services		11.96	10.50	11.82
Total		11.69	10.40	11.61
B. Percentage shares to GDP	*1970*	*1980*	*1990*	*2000*
Agriculture	32.03	23.42	14.97	8.41
Mining and quarrying	6.56	10.31	11.66	10.44
Manufacturing	13.92	20.52	23.84	31.14
Construction	4.01	4.75	3.84	3.87
Services	43.48	41.00	45.69	46.14
C. Average monthly income	*1970*[a]	*1980*[a]	*1990*	*2000*
Malay	172	492	940	1,984
Chinese	394	938	1,631	3,456
Indian	304	756	1,209	2,702
Other	n.a	n.a	955	1,371
Urban	428	975	1,617	3,103
Rural	200	550	951	1,718
D. Average monthly income growth rates (%)		*1970-2000*	*1990-2000*	*1970-2000*
Malay		8.42	7.02	8.19
Chinese		6.70	7.06	7.24
Indian		6.79	7.58	7.29
Other		n.a	3.34	n.a
Urban		6.53	6.10	6.59
Rural		7.70	5.52	7.17

Sources: Department of Statistics (2004, 2006) and Economic Planning Unit (various years)
Notes: ([a]) refer to the Peninsular Malaysia only
All figures are expressed in current prices
n.a = not available

Table 2: A new schematic Malaysian SAM for 1970

			Expenditures									
			1	2	3	4	5	6	7	8	9	
			Production activity	Factor of production	Institutions			Consolidated capital	Rest of the world (ROW)		Indirect tax	Total
					Household	Company	Government		Current	Capital		
Incomes	1	Production activity	Intermediate demands		Consumption of domestic commodities		Consumption of domestic commodities	Investment expenditures on domestic commodities	Exports			Gross output (aggregate demand)
			($T_{1,1}$)		($T_{1,3}$)		($T_{1,5}$)	($T_{1,6}$)	($T_{1,7}$)			(y_1)
	2	Factor of production	Value added Payments						Factor incomes received from a broad			Total factor income
			($T_{2,1}$)						($T_{2,7}$)			(y_2)
	3	Institutions: Household		Compensation of employees and unincorporated business profits		Distributed profits	Pensions and periodical payments		Social benefits received from abroad			Total incomes household
				($T_{3,2}$)		($T_{3,4}$)	($T_{3,5}$)		($T_{3,7}$)			(y_3)
	4	Institutions: Company		Corporate business profits			Current transfers		Non-factor incomes from abroad			Total incomes company
				($T_{4,2}$)			($T_{4,5}$)		($T_{4,7}$)			(y_4)
	5	Institutions: Government			Income taxes	Corporate taxes			Non-factor incomes from abroad		Indirect tax	Total government revenue
					($T_{5,3}$)	($T_{5,4}$)			($T_{5,7}$)		($T_{5,9}$)	(y_5)
	6	Consolidated capital			Household savings	Corporate savings	Public Savings			Capital transfer from abroad		Aggregate saving
					($T_{6,3}$)	($T_{6,4}$)	($T_{6,5}$)			($T_{6,8}$)		(y_6)
	7	Rest of the world (ROW): Current	Imports of intermediate inputs	Factor incomes paid abroad		Non-factor incomes paid abroad	Consumption of imported commodities					Total exchange paid
			($T_{7,1}$)	($T_{7,2}$)		($T_{7,4}$)	($T_{7,5}$)					(y_7)
	8	Rest of the world (ROW): Capital						Net investments abroad	Balance of payment current deficit			Total capital paid abroad
								($T_{8,6}$)	($T_{8,6}$)			(y_8)
	9	Indirect tax	Commodity taxes									Total indirect tax
			($T_{9,1}$)									(y_9)
			Gross input (total cost)	Total factor Payment	Total expenditures household	Total expenditures company	Total expenditures government	Aggregate investment	Total exchange earning	Total capital received from abroad	Total indirect tax	
			(y'_1)	(y'_2)	(y'_3)	(y'_4)	(y'_5)	(y'_6)	(y'_7)	(y'_8)	(y'_9)	

Table 3: Decomposition of changes in household income 1970-2000

		Rural Malay	Rural Chinese	Rural Indian	Rural Other	Urban Malay	Urban Chinese	Urban Indian	Urban Other	Total
Total changes (1970-2000)										
MR billion	(1)	16.26	4.43	2.12	4.24	36.53	37.39	8.57	3.09	112.63
Growth rate (%)[a]	(2)	3.41	1.89	2.59	9.50	8.09	5.30	5.92	5.36	4.98
Decomposition of total changes (%)										
Chg. in intermediate inputs (ΔA_a)	(3)	20.1	38.9	29.2	-1.8	5.1	16.1	21.9	-12.6	13.2
Chg. in labour and capital (ΔA_v)	(4)	-180.1	-559.5	-291.6	10.9	-19.2	-133.2	-95.0	-119.9	-114.0
Chg. in wages (ΔA_w)	(5)	-49.3	-104.4	-40.6	18.1	12.2	6.7	-6.6	12.6	-5.3
Chg. in consumption (ΔA_c)	(6)	-2.3	13.7	11.8	1.4	2.6	3.0	10.7	5.0	3.3
Chg. in distributed profit (ΔA_t)	(7)	-4.2	-68.3	-3.1	4.6	-0.3	-27.3	-0.8	3.6	-12.3
Chg. in govt. consumption (ΔZ_g)	(8)	47.6	69.4	51.6	15.4	21.8	20.3	26.7	29.2	27.8
Chg. in investment (ΔZ_s)	(9)	35.4	103.5	43.7	7.0	10.0	30.6	18.7	23.0	25.7
Chg. in exports (ΔZ_e)	(10)	219.6	585.8	283.7	40.1	60.6	176.1	115.9	153.3	152.7
Chg. in factor transfer (ΔZ_f)	(11)	6.9	14.4	7.7	2.0	2.5	4.5	3.8	3.2	4.5
Chg. in institutional transfer (ΔZ_h)	(12)	6.2	6.6	7.6	2.4	4.7	3.2	4.8	2.5	4.4

Sources: computed from equations (13) and (14)
Notes: ([a]) indicates average annual growth rates

Table 4: Decomposition of changes in labor income 1970-2000

	Total changes		Decomposition (%)		
	MR billion.	Growth rate (%)[a]	ΔA_v	(ΔZ_e)	Others[b]
	(1)	(2)	(3)	(4)	(5)
Rural-Malay-unskilled	-1.60	-1.27	-1,227.7	949.5	178.2
Rural-Malay-skilled	11.49	9.54	25.1	36.5	38.3
Rural-Chinese-unskilled	-1.05	-1.35	-1,528.4	1,211.4	217.0
Rural-Chinese-skilled	3.52	6.39	-75.4	104.0	71.4
Rural-Indian-unskilled	-0.33	-1.03	-1,236.8	887.7	249.1
Rural-Indian-skilled	1.14	7.11	-39.4	67.4	72.0
Rural-other-unskilled	0.90	8.71	28.3	58.4	13.3
Rural-other-skilled	1.37	7.28	25.8	28.0	46.2
Urban-Malay-unskilled	0.32	0.52	-3,620.6	2,453.3	1,267.3
Urban-Malay-skilled	21.42	10.26	29.3	32.2	38.5
Urban-Chinese-unskilled	1.28	0.81	-3,063.8	2,314.1	849.7
Urban-Chinese-skilled	20.49	7.87	-33.3	92.0	41.4
Urban-Indian-unskilled	0.55	1.98	-873.7	583.1	390.6
Urban-Indian-skilled	4.47	8.25	-12.9	55.5	57.3
Urban-other-unskilled	0.48	5.97	-55.3	99.0	56.3
Urban-other-skilled	1.03	3.30	-300.1	325.1	75.0

Sources: computed from equations (13) and (14)
Notes: ([a]) indicates average annual growth rates. ([b]) shows a total contribution of the rest of the components.
ΔA_a = changes in intermediate inputs; ΔZ_e = changes in exports.

Table 5: Distributional effects of components on changes in labor income, employment and inequality

		Rural Malay	Rural Chinese	Rural Indian	Rural other	Urban Malay	Urban Chinese	Urban Indian	Urban other	Total
A. Distribution of labor income (%)										
Chg. in intermediate inputs (ΔA_a)	(1)	6.8	2.4	3.3	-1.5	19.1	58.9	17.3	-6.3	7.4
Chg. in labour and capital (ΔA_v)	(2)	-16.8	-18.8	-4.5	0.6	-5.3	-46.3	-5.4	-3.4	-99.5
Chg. in wages (ΔA_w)	(3)	-32.4	-16.2	-3.7	-0.6	-10.9	-31.2	-3.2	-1.8	-1.7
Chg. in consumption (ΔA_c)	(4)	-512.1	-29.8	16.8	12.9	220.4	181.6	176.4	33.6	0.3
Chg. in distributed profit (ΔA_t)	(5)	-28.1	-16.5	-3.9	-0.5	-11.1	-33.6	-4.2	-2.1	-3.1
Chg. in govt. consumption (ΔZ_g)	(6)	23.3	7.8	3.3	2.4	29.3	23.5	7.2	3.3	25.2
Chg. in investment (ΔZ_s)	(7)	16.6	15.5	2.9	0.9	12.7	43.6	4.9	2.9	20.2
Chg. in exports (ΔZ_e)	(8)	17.1	14.5	3.2	0.8	13.0	42.9	5.0	3.4	113.1
Chg. in factor transfer (ΔZ_f)	(9)	20.0	10.1	2.9	1.9	22.0	34.7	6.1	2.3	2.6
Chg. in institutional transfer (ΔZ_h)	(10)	24.9	14.3	3.6	0.9	14.5	34.7	5.0	2.1	1.0
B. Distribution of employment (%)										
Chg. in labour coefficient (ΔL)	(11)	-21.4	-26.2	-5.1	2.3	-4.7	-38.1	-7.1	0.4	-14.4
Chg. in intermediate inputs (ΔA_a)	(12)	15.4	20.5	3.7	-0.5	11.6	40.1	8.7	0.5	3.3
Chg. in labour and capital (ΔA_v)	(13)	-42.5	-15.4	-4.1	-6.6	-8.2	-18.9	-3.7	-0.7	-4.0
Chg. in wages (ΔA_w)	(14)	-49.5	-13.6	-4.0	-8.7	-7.2	-13.6	-2.6	-0.7	-0.2
Chg. in consumption (ΔA_c)	(15)	-404.7	82.1	3.9	-108.6	101.2	340.1	81.9	4.2	0.1
Chg. in distributed profit (ΔA_t)	(16)	-42.1	-15.7	-4.1	-6.4	-8.2	-19.1	-3.7	-0.7	-0.4
Chg. in govt. consumption (ΔZ_g)	(17)	33.9	11.4	4.0	3.7	19.6	19.9	6.1	1.4	2.5
Chg. in investment (ΔZ_s)	(18)	26.8	18.5	3.7	2.8	10.1	31.9	5.2	1.0	2.6
Chg. in exports (ΔZ_e)	(19)	28.0	18.5	4.1	2.9	10.1	30.0	5.7	0.7	16.2
Chg. in factor transfer (ΔZ_f)	(20)	36.0	16.4	4.1	5.0	9.4	23.6	4.9	0.7	0.2
Chg. in institutional transfer (ΔZ_h)	(21)	35.4	16.6	4.1	4.8	9.4	24.1	5.0	0.7	0.2
C. Theil inequality between-group										
Structural-inequality	(22)	-0.052	-0.061	-0.014	0.040	0.328	-0.012	0.007	0.025	0.260
Overall-inequality	(23)	-0.052	0.029	0.002	-0.034	0.027	0.084	0.012	-0.011	0.057
Share of income change	(24)	0.151	0.038	0.012	0.035	0.332	0.332	0.077	0.023	1.000
Share of employment change-structural	(25)	0.214	0.190	0.039	0.011	0.124	0.345	0.070	0.008	1.000
Share of employment change-overall	(26)	0.213	0.017	0.011	0.091	0.306	0.258	0.066	0.037	1.000
Contribution of components to inequality										
Chg. in intermediate inputs (ΔA_a)	(27)	-0.056	-0.052	-0.004	-0.017	0.096	0.227	0.119	-0.164	0.149
Chg. in labour and capital (ΔA_v)	(28)	0.156	-0.039	-0.004	0.015	0.023	-0.416	-0.020	-0.053	-0.339
Chg. in wages (ΔA_w)	(29)	0.137	-0.028	0.003	0.016	-0.046	-0.258	-0.006	-0.016	-0.198
Chg. in consumption (ΔA_c)	(30)	-1.206	0.302	0.248	0.275	1.716	-1.139	1.354	0.699	2.250
Chg. in distributed profit (ΔA_t)	(31)	0.114	-0.008	0.002	0.013	-0.033	-0.190	-0.005	-0.023	-0.132
Chg. in govt. consumption (ΔZ_g)	(32)	-0.088	-0.029	-0.006	-0.011	0.117	0.039	0.012	0.027	0.062
Chg. in investment (ΔZ_s)	(33)	-0.128	-0.032	-0.009	-0.032	0.023	0.099	-0.003	0.011	-0.071
Chg. in exports (ΔZ_e)	(34)	-0.084	-0.035	-0.007	-0.010	0.033	0.153	-0.007	0.054	0.097
Chg. in factor transfer (ΔZ_f)	(35)	-0.117	-0.049	-0.010	-0.018	0.187	0.134	0.014	0.028	0.168
Chg. in institutional transfer (ΔZ_h)	(36)	-0.088	-0.021	-0.005	-0.015	0.063	0.126	0.000	0.024	0.085

Sources: results in Panel A and B derived from equations (13) and (14), and (15), while results in Panel C derived from equation (C4) in appendix C.

Appendix A: Decomposition of changes in production output (billion MR)

	Changes	ΔA_a	ΔA_v	ΔA_w	ΔA_c	ΔA_t	ΔZ_g	ΔZ_s	ΔZ_e	ΔZ_f	ΔZ_h
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Other agricultural products	4.14	-1,550	-15,754	-1,215	-7,250	-1,524	3,326	3,103	24,058	480	466
Rubber products	3.26	-2,139	-2,472	-115	-780	-253	638	1,119	7,111	73	75
Oils and fats	35.63	11,185	-2,832	-257	605	-252	1,060	134	25,653	166	167
Meats and dairy	4.96	1,224	-15,664	-1,128	-7,381	-1,630	3,360	3,698	21,529	483	466
Wood and furniture	27.62	-1,513	-2,012	-99	-883	-182	740	5,548	25,886	63	67
Fish	3.49	1,111	-6,470	-369	-1,737	-850	1,280	1,355	8,785	204	182
Mining products	35.38	-22,111	-3,292	-185	490	-321	1,385	9,104	50,012	148	156
Food, drink and tobacco	4.82	-946	-32,417	-2,930	-16,506	-2,925	6,774	5,957	45,916	965	932
Other manufactured goods	106.70	8,865	-23,234	-875	-6,661	-2,471	6,836	15,613	106,980	814	829
Petroleum	24.14	-17,679	-10,795	-658	5,390	-1,042	3,645	4,642	39,730	444	465
Machinery and vehicles	253.73	-731	-10,517	-567	-1,425	-1,033	3,601	6,393	257,214	391	409
Electricity and water	15.92	3,356	-2,614	-134	1,221	-229	1,561	1,537	10,922	155	143
Construction	40.51	-6,803	-1,545	-76	1,663	-157	1,695	38,524	7,096	55	54
Trade, transport and comm.	101.15	26,657	-7,177	-125	5,490	-756	4,108	7,878	64,107	467	498
Private sector services	104.83	12,643	-17,711	-1,031	22,872	-1,727	10,579	9,748	67,199	1,171	1,091
Education and health	18.08	-6	-880	-48	2,486	-81	13,588	396	2,468	80	79
Government services	13.95	-486	-559	-28	-247	-55	14,021	142	1,128	15	15

Sources: computed from equations (13) and (14)

Notes: ΔA_a = changes in intermediate inputs; ΔA_v = changes in labour and capital; ΔA_w = changes in wages; ΔA_c = changes in consumption; ΔA_t = changes in distributed profit; ΔZ_g = changes in government consumption; ΔZ_s = changes in investment; ΔZ_e = changes in exports; ΔZ_f = changes in factor transfer; ΔZ_h = changes in institutional transfer. We define machinery and vehicles, and other manufacturing sectors as the non-resource-based activities and the rest of other non-services sectors as the resource-based activities.

Appendix B: Employment in public and private sectors by ethnic groups

	1970 (' 000)			2000 ('000)		
	Public	Private	Total	Public	Private	Total
Rural Malay	130.5	1,111.3	1,241.8	428.1	2,100.6	2,528.7
Rural Chinese	23.4	529.8	553.2	31.1	627.1	658.2
Rural Indian	19.2	172.2	191.4	19.9	235.7	255.6
Rural other	3.6	12.6	16.2	74.9	493.4	568.2
Urban Malay	82.5	112.4	194.9	584.1	1,457.9	2,041.9
Urban Chinese	54.4	426.7	481.1	139.8	1,901.0	2,040.8
Urban Indian	31.0	66.2	97.2	69.1	426.2	495.3
Urban other	4.3	4.7	9.0	48.5	183.5	232.0

Sources: Pyatt and Round (1984) for 1970 and DOS (2001) for 2000.

Appendix C: Theil index and the treatment of logarithmic negative values

Let total income and employment of a partitioned group be unity (so that income and employment are expressed as shares). Denoting the income share of group i as y_i and employment share of the group as n_i, Theil (1967) index of inequality can be written as:

$$T = \sum_{i=1}^{n} y_i^k \log\left(\frac{y_i^k}{n_i^k}\right) + \sum_{i=1}^{n} y_i^k \sum_{j=1}^{ni} y_{ij}^k \log\left(\frac{y_{ij}^k}{n_{ij}^k}\right) \quad \text{(C1)}$$

$$T = T_b + T_w \quad \text{(C2)}$$

where y_{ij} is the subgroup of j's share of group i's income, n_{ij} is subgroup j's employment share of group i and k is types of income-driven components (e.g. generation of income by consumption, investments, exports and so on). The first term (T_b) is between-group inequality and the second term (T_w) is average within-group inequality. Decomposition of Theil index into within-group inequality can be achieved if data at disaggregated level are available. Concentrating on the between-group inequality, the similar approach is applied for the estimation of inequality due changes in income and employment as follows:

$$T_b = \sum_{i=1}^{\Delta n} \Delta y_i^k \log\left(\frac{\Delta y_i^k}{\Delta n_i^k}\right) \quad \text{(C3)}$$

where Δy^k_i indicates share of income changes of group i by k types of income-driven components and Δn_i denotes share of employment changes of group i.

The Theil index fails when numerator or denominator of the second-term right-hand side of (C3) contains negative values because logarithm of the negative values cannot yield real numbers. In Panel A and B of Table 5, the logarithm of negative values arise from the following observations, as appeared in column (2) and (3) of Table A below.

Table A: logarithm of negative values by using small value (SV) strategy

	Sources	Δy_i^k	Δn_i^k	SV strategy: Log $\left(^{-/+}\Delta y_i^k \big/ \delta^{-/+}\right)$	SV strategy: Log $\left(\delta^{-/+} \big/ {}^{-/+}\Delta n_i^k\right)$	Theil ((4)+(5))*(2)
	(1)	(2)	(3)	(4)	(5)	(6)
Urban other	ΔA_a	-0.063	0.005	20.267*	-17.672*	-0.164
Rural other	ΔA_v	0.006	-0.066	20.309*	-17.932*	0.015
Rural Chinese	ΔA_c	-0.298	0.821	21.815*	-22.828*	0.302
Rural other	ΔA_c	0.129	-1.086	23.109*	-20.978*	0.275

Notes: (*) denotes the computations are converge at $-/+10^{-10}$.

Since the measurement concept of the Theil index is generally similar to the logarithmic mean divisia index (LMDI), we may apply the alternative computation procedures that have been proposed in the LMDI-related literature. In this respect, small value (SV) and analytical limit (AL) strategies have been proposed to tackle logarithm of negative values (see Ang and Liu, 2007a; Ang and Liu, 2007b; Ang, 2005). We choose to use the SV strategy because it is easier to understand and implement. The SV strategy is usually applied to overcome a zero-value problem in the LMDI. That is, when a dataset contains a zero value, the zero value can be replaced by a small positive number (δ), e.g., between 10^{-10} and 10^{-20}, and the computation could be proceed as usual. Choi and Ang (2002), and Choi and Ang (2001), show that a value of δ between 10^{-10} and 10^{-20} generally gives satisfactory results. Following Ang and Liu (2007b) and Wu et al. (2006), the expression below is used to overcome our constraint:

$$\Delta T_b = \sum_{i=1}^{\Delta n} \Delta y_i^k \sum_{i}^{\Delta n} \log\left(\frac{^{-/+}\Delta y_i^k}{\delta^{-/+}}\right) + \log\left(\frac{\delta^{-/+}}{^{-/+}\Delta n_i^k}\right) \qquad \text{(C4)}$$

In (C4), change in a unity interval is divided into two parts, with the zero value taken as the point of demarcation: change from/to the negative value to/from zero, and a change from/to a zero to/from the positive value. For each part, the SV strategy is applied to handle the zero-value problem. The final result is given by the sum of the results of the two parts, i.e., summation of

columns (4) and (5) of Table A. Then, the estimation of Theil index by using the SV strategy can be derived as usual as in column (6).

Appendix D: Decomposition of changes in employment (million workers)

		Rural Malay	Rural Chinese	Rural Indian	Rural other	Urban Malay	Urban Chinese	Urban Indian	Urban other	Total
Total changes	(1)	1.29	0.11	0.06	0.55	1.85	1.56	0.40	0.22	6.04
Chg. in labour coefficient (ΔL)	(2)	-3.08	-3.77	-0.74	0.33	-0.68	-5.49	-1.03	0.06	-14.40
Chg. in intermediate inputs (ΔA_a)	(3)	0.50	0.67	0.12	-0.01	0.38	1.31	0.28	0.02	3.26
Chg. in labour and capital (ΔA_v)	(4)	-1.68	-0.61	-0.16	-0.26	-0.32	-0.75	-0.15	-0.03	-3.96
Chg. in wages (ΔA_w)	(5)	-0.11	-0.03	-0.01	-0.02	-0.02	-0.03	-0.01	0.00	-0.23
Chg. in consumption (ΔA_c)	(6)	-0.39	0.08	0.00	-0.10	0.10	0.33	0.08	0.00	0.10
Chg. in distributed profit (ΔA_t)	(7)	-0.17	-0.06	-0.02	-0.03	-0.03	-0.08	-0.01	0.00	-0.40
Chg. in govt. consumption (ΔZ_g)	(8)	0.84	0.28	0.10	0.09	0.49	0.49	0.15	0.04	2.48
Chg. in investment (ΔZ_s)	(9)	0.71	0.49	0.10	0.07	0.27	0.84	0.14	0.03	2.63
Chg. in exports (ΔZ_e)	(10)	4.55	3.01	0.66	0.47	1.64	4.86	0.93	0.11	16.22
Chg. in factor transfer (ΔZ_f)	(11)	0.06	0.03	0.01	0.01	0.02	0.04	0.01	0.00	0.17
Chg. in institutional transfer (ΔZ_h)	(12)	0.06	0.03	0.01	0.01	0.02	0.04	0.01	0.00	0.17

Sources: computed from equation (15)