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MALAYSIA
MEASURING AND MONITORING POVERTY AND INEQUALITY

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FOREWORD

In the last quarter of the twentieth century, Malaysia's economic transformation was little short of spectacular. At the time of independence in 1957, Malaysia was a low-income, predominantly agricultural and rural economy. Around half of the country's households were living below the national poverty line, with very little changed up to 1970, at which time 49 per cent of households were poor. In the following three and a half decades, rapid economic growth and structural change have transformed Malaysia into a prosperous, urban, and industrialized economy. By the end of the century, Malaysia's poverty rate had fallen below 10 per cent, and in 2007 to less than 5 per cent. The nation has attained high human development.

Malaysia's economic transformation owes much to its human and its natural resources. It also owes much to the sound economic, social, and commercial policies pursued, as well as political stability and national unity. Two broad features of the post-1970s have helped to reduce poverty: the country's enviable economic growth record and the national commitment to a more equitable distribution of income.

At the beginning of the 1970s, the Malaysian economy relied largely on the production of primary products (natural rubber, tin, and palm oil) for world markets. Successive commercial policies gradually dismantled barriers to trade so that the country is today one of the world's most globalized economies. Manufacturing, rather than agriculture, has been primarily responsible for the country's export successes in recent decades. Exports of manufactured goods, particularly of electrical and electronic products, have been the key factor in sustained rapid economic growth.

Malaysia has also enjoyed macroeconomic stability. Liberal commercial policies and bold financial management have been important factors behind Malaysia's strong and sustained growth record. Some economists have argued that economic growth, with its correlate of increased modern sector employment, is an essential pre-condition for poverty reduction: Malaysia provides an excellent illustration.

Malaysian governments have also aimed for a more equitable distribution of income and this is the second feature of the post 1970 period that has contributed to poverty reduction. Rural development programmes helped to raise the incomes of impoverished agricultural communities.

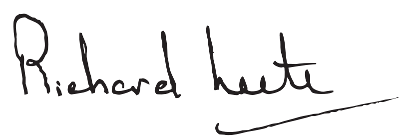
The New Economic Policy (NEP), formulated in 1970, sought to lessen the association of race with economic function. Policies were motivated by the idea that all communities should share in the country's growing prosperity. Successive five-year plans have sought to achieve 'growth with distribution'. This open commitment to economic prosperity for all has been an important ingredient in Malaysia impressive poverty record.

While the national poverty rate is extremely low by historical standards, there are still substantial spatial and community variations. Thus, for example, there remain relatively large numbers of poor households living in poverty in rural Sabah and Sarawak, as well as in the rural areas of Terengganu, Kelantan, and Kedah. The overwhelming majority of the country's remaining poor are Bumiputera; especially prominent are the indigenous communities in Sabah and Sarawak.

Malaysia aims to improve on the poverty targets set through the Millennium Development Goals (MDGs). The Ninth Malaysia Plan, 2006–2010, repeated the commitment to achieve growth with distribution and set targets of reducing the overall poverty rate to 2.8 per cent and eradicating hard-core poverty by 2010. It also set ambitious targets to narrow income disparities and improve equity. In order to help achieve these targets, it is essential for policymakers to work with refined and disaggregated measures of poverty and inequality. This monograph describes and illustrates a range of useful approaches that can be used to measure and monitor poverty and income inequality.

We would like to thank members of the Project Team (listed on page xi of this monograph) from the Distribution Section of the Economic Planning Unit (EPU), the Department of Statistics (DOS) Malaysia, and UNDP for their excellent collaboration in putting this monograph together, under the able technical leadership of Mr David Demery of the University of Bristol with close support from Dr Chung Tsung Ping. We are confident that the publication will be of considerable value to all those interested in measuring and monitoring poverty and income inequality. We hope that it will also prove to be a useful tool for policymakers and practitioners in other developing countries and serve as a technical tool in South–South Cooperation for the achievement of the MDGs.

Dato' Sri Dr Sulaiman Mahbob
Director General
Economic Planning Unit



Dr Richard Leete
UNDP Resident Representative
Malaysia, Singapore and Brunei Darussalam

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ABBREVIATIONS

CBN	cost of basic needs
CDF	cumulative distribution function
CPI	consumer price index
DOS	Department of Statistics (Malaysia)
EPU	Economic Planning Unit
EU	European Union
FEI	food energy intake
FGT	Foster, Greer, and Thorbecke (index)
GDP	gross domestic product
HES	Household Expenditure Survey
HIS	Household Income Survey
HPI	human poverty index
MDG	Millennium Development Goal
MOH	Ministry of Health
NGOs	non-governmental organizations
OECD	Organisation for Economic Co-operation and Development
PAL	physical activity level
PDC	poverty deficit curve
PIC	poverty incidence curve
PLI	poverty line income
PPA	participatory poverty assessment
PPP	purchasing power parity
PPRT	Program Pembangunan Rakyat Termiskin
PRA	participatory rural assessment
PSC	poverty security curve
TIP	three 'I's' of poverty
UKM	Universiti Kebangsaan Malaysia
UNDP	United Nations Development Programme
UPM	Universiti Putra Malaysia

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Also acknowledged are members of the Strengthening Capacity in Policy Formulation, Monitoring and Evaluation for Poverty Eradication project's National Steering Committee and the Technical Working Committee.

1 INTRODUCTION

INTRODUCTION

Malaysia was amongst the first developing countries to define a 'national poverty line income' (PLI): an income level which defines 'absolute poverty'. Its official PLI was first formulated in 1977 and, until 2005, this was used to monitor the country's progress in eradicating poverty. In 2005 the PLI was substantially revised to make it more comprehensive and more generous than its 1977 predecessor.

The three broad aims of this monograph are

- to define and explain different measures of poverty and income inequality, especially the rationale behind Malaysia's revised PLI;

- to illustrate these measures using the Malaysian experience over the decade since 1995, with data from the Malaysian Household Income Surveys (HIS) undertaken in the years 1995, 1997, 1999, 2002, and 2004; and

- to show how the various measures can be used to inform policies aimed at reducing poverty and inequality.

This chapter reviews the main approaches that have been used to define poverty. Chapter 2 explains the methodology used in Malaysia's new 2005 PLI. Chapter 3 discusses a number of important indices that aim to measure the incidence, intensity, and severity of poverty. Chapter 4 applies these measures to successive Malaysian Household Income Surveys over the period 1995–2004. Chapter 5 analyses the Malaysian income inequality more generally, using graphical methods as well as through the application of indices of income inequality.

The Dimensions of Poverty

Most people have little difficulty in answering the question, 'Do you consider yourself to be poor?' Yet, in practice, establishing which individuals or households to classify as poor is not as simple as it may first appear: poverty is easily recognized but difficult to define. Mollie Orshansky, the economist who set up the first US poverty line, suggested that 'poverty, like beauty, lies in the eyes of the beholder' (Orshansky 1969: 37). Perhaps poverty is hard to define because it is multidimensional. The immediate and natural way to think of poverty is in terms of monetary income: individuals or households are poor because they lack sufficient command over resources. According to the *Concise Oxford Dictionary*, the adjective poor means 'lacking adequate money or means to live comfortably'. But poverty can have less obvious dimensions: vulnerability to risks, powerlessness, lack of personal freedom, and social exclusion. Poverty analysis has increasingly recognized the importance of these wider aspects of human poverty.

The Development Co-operation Directorate of the OECD set out five key 'capabilities' (OECD 2001) required for individuals to escape poverty:

- Economic capabilities: ability to earn income, consume goods, and possess assets.
- Human capabilities: health, education, nutrition, clean water, and shelter.
- Political capabilities: human rights.

- Sociocultural capabilities: the ability to participate as a valued member of a community.
- Protective capabilities: the ability to withstand economic and external shocks.

In most practical settings, the inability to afford an adequate diet is the central element of the PLI and it is not surprising that the United Nations Millennium Declaration (UN 2000) linked the twin aims of eradicating extreme poverty and hunger. But individuals may also consider themselves poor if they lack access to schooling or health care; or if they have no access to safe drinking water or sanitation services, aspects of daily life that most of us take for granted. And there is a deep-rooted social dimension to poverty. Poor people are often those who are incapable of participating fully in social life without a feeling of shame—individuals who are, in Adam Smith's phrase, 'afraid to appear in public'. The absence of this *capability* is, according to Sen (1976b), the essential characteristic of poverty. Reflecting this multidimensionality, the Millennium Development Goals (MDGs) aim to cut poverty in several key dimensions: income, hunger, lack of education, gender inequality, disease, environmental degradation, and lack of access to basic services and infrastructure.

Composite Poverty Measures

One way to monitor a country's progress in eradicating poverty is to examine the behaviour over time of poverty's correlates: infant mortality, life expectancy, literacy rates, etc. The United Nations Development Programme (UNDP) human poverty index (HPI) for developing countries combines measures such as people not expected to survive to 40; illiteracy; access to safe water; access to health services; and underweight children—all directly associated with poverty.[1] Malaysia's HPI of 8.3 places it at rank 15 amongst developing countries (UNDP 2006: Table 3).

The multidimensional nature of poverty has led to explicit measures that supplement income or consumption with the correlates of poverty or indicators of deprivation. Peter Townsend's (1979) approach was to calculate a 'deprivation index' for each household. The index was based on such diverse factors as the lack of or non-participation in holidays; having an evening out; fresh meat four days a week; regular cooked meals; possession of a refrigerator and cooker; and sole use of flush toilet, sink, bath, or shower. A deprivation score is obtained as the sum of unmet items. Townsend's approach was an early example of several that followed.

In Ireland, household disposable income per equivalent adult is combined with a 'relative deprivation' index to define poverty and this general approach is sometimes referred to as the 'Irish' method.[2] This index currently consists of the following eight basic deprivation indicators:

- Not having:
  - ~ new, but second-hand clothes;
  - ~ a meal with meat, fish, or chicken every second day;
  - ~ a warm waterproof overcoat;
  - ~ two pairs of strong shoes;
  - ~ a roast or its equivalent once a week;

[1] The formula used to calculate the poverty index for developing countries is $HPI = \left[\frac{(P_1^{\alpha} + P_2^{\alpha} + P_3^{\alpha})}{3}\right]^{1/\alpha}$, where P_1 is the percentage probability at birth of not surviving to age 40, P_2 is the adult illiteracy rate and P_3 is the unweighted average of proportion of the population without sustainable access to an improved water source and the proportion of underweight children.

[2] The deprivation indicators were first identified in 1987 by Ireland's Economic and Social Research Institute. Whelan et al. (2006) offer a recent appraisal of this approach in which they suggest changes to the list of deprivation items.

- or conversely, having:
  - ~ debt problems arising from ordinary living expenses;
  - ~ a day in the last two weeks without a substantial meal;
  - ~ to go without heating during the last year through lack of money.

If a household in Ireland receives income per adult equivalent below 60 per cent of average or median income and also lacks at least one of the items in the basic deprivation list, it is said to experience 'consistent poverty'. The UK government currently uses a three-pronged definition of poverty: a relative income measure, an absolute income measure, and an index of material deprivation, much like the Irish one.

International PLIs

When measuring world poverty and its trend, it clearly makes sense to adopt the same threshold income or PLI for each country. Measuring world poverty by counting individuals with incomes below their national PLIs makes little sense. Households defined as poor in the United States enjoy standards of living far above those defined as poor by the national PLIs in the poorest countries.

The UN's MDGs adopted *international* poverty standards of US$1-a-day and US$2-a-day and the World Bank has used these standards when monitoring global trends. More accurately the lower of the two international PLIs was US$1.08 per person per day in 1993, and the higher PLI was US$2.15.[3] The former was based on the lowest ten poverty lines among a set of low-income countries (Chen and Ravallion 2001), so it really represents the 'lowest common denominator' amongst national PLIs. For this reason, it represents a very modest standard for rich and middle-income countries and it has been much criticized for this reason. Nevertheless, as Deaton (2003) has put it, based as it is on poverty thresholds of the poorest countries, 'it is hard to think of a more appropriate definition for international poverty than being poor in the poorest nations'.

It is of some interest to investigate the proportion of Malaysians poor by these two widely recognized international standards. To do this we need to convert the PLI in US dollars into Malaysian ringgit. It would be tempting simply to use the official rate of exchange between the two currencies. So, for example, in the market for foreign exchange US$1 would have purchased (on average) RM2.57 in 1993, when the standards were set. This would mean that the international PLIs per person for Malaysia would have been RM84 and RM168 per month, corresponding to US$1 and US$2 a day. Although easily implemented, this approach would give very distorted results. In the first place, when they are allowed to float, exchange rates are only affected by international trade in 'tradable' goods and services. So the exchange rate may reflect differences in the prices of many tradable goods. But it will not reflect differences in the prices of non-traded goods. Moreover, the exchange rate is substantially influenced by movements of capital between countries—movements that will have little to do with relative costs of living. Furthermore, in the Malaysian case, until recently, the exchange rate against the dollar was pegged.[4] As a result, the official exchange rate is unlikely to be an accurate

[3] Throughout this monograph, US$1-a-day (US$2-a-day) should be taken as a short-hand expression for US$1.08 a day (US$2.15 a day).

[4] Following the 1997 Asian financial crisis, on 1 September 1998 Malaysia's Central Bank fixed the ringgit's value at RM3.80 to US$1 (its immediate pre-crisis value was RM2.60, but in January 1998 it had depreciated to RM4.88). In July 2005, the exchange rate was de-pegged and the ringgit has subsequently steadily appreciated against the US dollar. The exchange rate is now managed by Malaysia's Central Bank on the basis of a basket of foreign currencies.

measure of cost of living differences between Malaysia and the United States. In most cases, and Malaysia is no exception, the application of official exchange rates would set far higher PLI standards than intended. A Malaysian earning RM2.57 per day in 1993 would achieve a far higher standard of living than a United States citizen earning US$1 a day. The use of official exchange rates would set very different standards in different countries.

For this reason the US dollar PLIs need to be converted into local currency equivalents using 'purchasing power parity' (PPP) exchange rates. These attempt to answer the simple question: 'How many ringgit would be required to purchase the same quantity of goods in Malaysia that a dollar can purchase in the US?' Because of the variety of goods consumed, some of which may be unique to one or the other country, this is not as straightforward as it sounds. PPP exchange rates are index numbers and their construction is subject to all the problems associated with such indices.

The World Bank has calculated a consumption PPP which estimates the number of ringgit required to buy a basket of consumer goods that would cost US$1 to purchase in the United States. In 1993 the consumption PPP for Malaysia[5] was RM1.579, around 60 per cent of the official exchange rate. Unfortunately, even this currency conversion is likely to give a distorted comparison of costs of living amongst the poor. This is because the consumption PPP is calculated for all consumption goods, rather than those goods typically consumed by poorer households. It makes no sense to include in our conversion of the US$1-a-day PLI the price of luxury items like expensive cars or five-star hotels. In particular, the consumption PPP exchange rate will typically give less weight to differences in food prices than is desirable for an index of prices faced by the poor. With this caveat in mind, and in the absence of a separate PPP for those consumer goods typically consumed by low-income earners (especially food), we use the World Bank's consumption PPP.

Table 1.1 sets out the two international PLIs expressed in Malaysian ringgit. Using the World Bank's consumption PPP exchange rate, the 1993 PLIs were RM52 and RM103 per person per month for the US$1 and US$2 standards respectively. These were updated for the years 1995, 1997, 1999, 2002, and 2004 to reflect changes in consumer prices in Malaysia as measured by the national consumer price index (CPI). The use of the CPI for comparing price changes over time is subject to the same set of problems as the use of the consumer PPP for comparisons of living costs across countries. In particular, the CPI is based on the price of an *average* bundle of consumer goods rather than the price of a bundle of goods typically consumed by poor households.[6]

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[5] See Ahmad (2003).

[6] Deaton (1998) calculated that the US CPI is representative of a household at around the 75th percentile, 'further reinforcing the divergence between what we get—the national consumer price index—and what we want—a price index for the poor' (Deaton 2003).

TABLE 1.1 International and National PLIs

Year	International PLI per person RM per month US$1 a day	RM per month US$2 a day	2005 PLI RM per month Mean PLI per capita
1995	55	110	127
1997	59	117	137
1999	64	127	152
2002	67	133	161
2004	69	136	166

As will be explained in Chapter 2, the 2005 methodology used to set the national Malaysian standard defines separate PLIs for every household in the household surveys used to measure poverty, a PLI that reflects the household's demographics and location. The 2005 PLI in Table 1.1 is the weighted average of households' PLIs per capita. The PLIs for the earlier years (1995–2002) were derived by applying CPI adjustments to their 2004 values. Differential adjustments were applied by region (Peninsular Malaysia, Sabah, and Sarawak) and stratum (urban–rural). Although comparisons of the national and international PLIs are not straightforward,[7] the average national PLI is distinctly above the US$2-a-day threshold.

The poverty rates as measured by national and international standards are set out in Table 1.2. Columns 2 and 3 give the proportions of *households* with per capita gross income below the two international standards. In 1995 around 1 per cent of Malaysian households were poor by the US$1-a-day standard and 9 per cent by the US$2-a-day PLI. The proportion of households with per capita incomes below US$2-a-day had halved by the year 2004. Columns 4 and 5 present the proportion of *individuals* in households with per capita income below the international standards. Because poor households tend to be larger, on account of the larger number of children that they tend to have, the proportion of individuals defined as poor is greater than the proportion of households. By 2004 the proportion of poor individuals was less than 1 per cent by the US$1-a-day standard and just under 7 per cent by the US$2-a-day.[8]

The final two columns of Table 1.2 report poverty rates using the Malaysian 2005 methodology: the proportion of poor households in column 6 and poor individuals in column 7. Reflecting the higher national thresholds shown in Table 1.1, poverty rates defined by the national standard are higher than those given by the higher international standard.

[7] The national PLI in Table 1.1 is based on the mean PLI per capita of all households. Had we taken the mean PLIs per capita of poor households, the figure would be a little lower: in 2004 the mean of poor households was RM157, compared with RM166 over all households.
[8] Our estimates for 1997 differ slightly from those reported by the World Bank: their estimate for that year was 9.3 per cent using the US$2-a-day standard compared with 8.3 per cent in Table 2.2. The difference is possibly due to the use of different CPI adjustments.

TABLE 1.2 Poverty Rates by International and National Standards

Year	International Standards				2005 PLI	
	Households		Individuals		Households	Individuals
	US$1 a day	US$2 a day	US$1 a day	US$2 a day		
1995	1.37	8.98	2.10	12.25	9.86	12.64
1997	0.61	5.83	0.95	8.29	6.67	8.83
1999	0.75	6.53	1.11	9.25	8.14	10.80
2002	0.51	5.12	0.78	7.37	6.19	8.40
2004	0.40	4.46	0.65	6.94	5.96	8.68

Source: HIS for relevant years.

Approaches to Defining Poverty

Ravallion (1994) identified two broad conceptual approaches to defining poverty: 'welfarist' and the 'non-welfarist'. This section explains the thinking behind each.

The Welfarist Approach

The welfarist approach is grounded in microeconomic theory where individuals and households are assumed to maximize what economists call 'utility' or psychic well-being. In this approach, an individual is said to be poor if her *utility* falls below a target or threshold level. If all individuals had the same preferences and faced the same prices, a single PLI could be defined for all—an income level that would deliver the threshold level of utility. Individuals with income below this line would be deemed to be poor. However, if tastes vary across individuals or if they face different prices, there would be a separate PLI for every individual as each would need a different income to achieve the threshold utility level.

To appreciate the importance of different preferences, consider the example of an individual who attaches a very high value to leisure. Because of this, s/he will prefer to work and earn very little, choosing instead leisure time over the consumption of goods and services. The resulting low income is of the individual's choosing. The income s/he requires to achieve the threshold level of utility is well below that of another individual who attaches less weight to leisure time and more to consumption. According to the welfarist approach the leisure-loving individual would not be considered poor even were her income to be substantially lower than that considered adequate for the average person.

This example illustrates the practical impossibility of strictly applying the welfare approach. It would not only require information about the individual's income and the prices s/he faces (both of which we generally have) but also enough information about her/his preferences to judge whether s/he has attained the threshold level of utility. In standard income or expenditure surveys, the leisure-loving individual who chooses to work and earn little would be indistinguishable from an individual who is unemployed or underemployed not from choice but because of the absence of employment opportunities. Poverty reduction programmes that are simply based on income will not distinguish individuals whose income is low through choice from those who wish to work but cannot find it.

Moreover, the welfare approach attempts to make interpersonal comparisons of utility, something welfare economists have long considered impossible. It might be possible to obtain some measure of utility from surveys which directly ask respondents to assess their state of mind or contentment.[9] Using such a measure, the welfarist approach might well define someone as poor who is materially well off but who is not happy or content and it might define someone as non-poor who is materially deprived but content. Basing a poverty measure on such obviously subjective responses is problematic. In Sen's (1983) words, why should the 'grumbling rich' be judged poorer than the 'contented peasant'? We return to subjective assessments of poverty later in the chapter.

Given the assumption of identical tastes, it would be possible to derive a common 'welfarist' PLI for all individuals facing the same prices. Applying this common PLI to a sample of individuals with heterogeneous tastes would mean that some individuals whose income falls below this PLI will be 'utility-non-poor' and some with income above the line will be 'utility-poor'. Since it is impossible to allow fully for taste variations, the practical question is, how many individuals are incorrectly identified as poor (sometimes called 'Type II error') and how many utility-poor are missed because their incomes are above the PLI ('Type I error')? Since our focus is on individuals at the bottom end of the distribution, variations in tastes can be expected to be of second order, so that we would expect few misclassifications from the assumption of identical preferences.[10]

Non-Welfarist Approaches

There are two broad alternatives to the welfarist approach: the 'basic needs' and 'capability' approaches, both of which have been influenced by the important and influential work of Amartya Sen. Sen (1992: 39) introduced the concept of 'functioning' , which can vary from 'such elementary things as being adequately nourished, being in good health, avoiding escapable morbidity and premature mortality … to more complex achievements such as being happy, having self-respect, taking part in the life of the community, and so on'. The concept of basic needs is similar to that of functioning: 'Basic needs may be interpreted in terms of minimum quantities of such things as food, shelter, water and sanitation that are necessary to prevent ill health, undernourishment and the like' (Streeten et al. 1981). Both 'functioning' and 'basic needs' can be thought of as the result of combining inputs of several goods and services (and time). Being 'adequately nourished' would require appropriate inputs of clean water, nutritious foods, cooking utensils, cutlery, and so on. And some commodities may be required to achieve a number of different 'functionings': for example, good health requires not only medical service but also clean water and nutritious food.

[9] 'Happiness surveys' have been undertaken in many countries and in recent years there has been an explosion of research using them (see Frey and Stutzer 2002). As early as 1974, Richard Easterlin analysed data from thirty happiness surveys and found a positive relationship between income and respondents' declared 'state of happiness'. In his more recent review, Easterlin reports that 'in every representative national survey ever done a significant bivariate relationship between happiness and income has been found' (2001: 468).

[10] Samuelson's (1974) 'money-metric' and Blackorby and Donaldson's (1987) 'welfare ratio' approaches measure the distance from 'poverty utility' in different ways. For a helpful discussion on the issues, see Deaton and Zaidi (2002), who show that these approaches have implications for the choice of Paasche or Laspeyres price indices.

According to Sen's 'capability' approach, individuals are considered poor only if they lack the *capability to achieve* essential functionings. An individual may choose a poor diet in order to indulge some inessential personal weakness. But if this individual has the *capability* to achieve the 'adequately nourished' functioning, s/he would not be considered poor. It is the capability that matters.

This general principle is also central to the basic needs approach. Individuals are poor if they lack the resources to achieve basic needs. The fact that non-poor individuals choose to sacrifice a basic need for some other expenditure is irrelevant: if they have the resources to meet the basic needs, they are non-poor. It is capability that is important, not the actual patterns of spending. This is the central departure from the welfarist approach.

Ravallion (2001) has argued that it is possible to view Sen's capability approach 'through the lens' of utility theory. Utility depends on capabilities, but the achievement of these capabilities will require specific goods and services. According to Ravallion, the capability approach can help in identifying the consumption bundle necessary to escape poverty. He writes, 'It is more transparent, and likely to be more readily accepted in society at large, to define "poverty" in terms of people's abilities to lead a healthy and active life and to participate fully in the society around them, than as an abstract concept of "utility"' (Ravallion 2001: 11). But the Sen approach stresses capabilities not actual behaviour and, in this respect, it departs from the welfarist approach. By the Sen and basic needs approaches, an individual would be deemed to be non-poor even if s/he chose to fall short of every individual basic need: it is the capacity to achieve these needs that is important.

As Chapter 2 shows, the revised 2005 PLI for Malaysia broadly follows the basic needs approach but it takes account of household tastes in two ways. The food component of the PLI is based on a target caloric intake, met through a balanced diet. The basket of foods that make up this diet (rice, chicken, and so on) reflects the type of foods typically consumed in Malaysia. Secondly the non-food PLI is determined by the spending patterns of Malaysian households whose income is just above that required to meet the food PLI. As in most attempts to set PLIs, the Malaysian approach is a blend of objective standards and the preferences of Malaysian households, as revealed in the 2004 Household Expenditure Survey (HES).

Absolute versus Relative Poverty

In practice, two broad approaches have been used when defining the PLI. The 'absolute' poverty approach involves defining a minimum standard of living below which an individual or household is deemed to be poor. Its absolute nature implies that it does not automatically change as society at large enjoys an improved standard of living. This approach is usually based (at least in part) on nutritional needs, but there are a number of difficult conceptual and practical problems encountered in fixing this minimum standard. The second approach is the 'relative' poverty approach, which interprets poverty in relation to the prevailing standards of the society at the time. This approach recognizes explicitly the interdependence between the poverty line and incomes throughout the entire distribution. Writing of poverty in the United Kingdom, Townsend (1979) defined it as a 'failure to keep up with the standards prevalent in a given society'.

However, the distinction between relative and absolute PLIs is often blurred in practice. Countries that adopt the absolute poverty approach tend to set higher standards the higher the country's average standard of living is. So there is an inevitable blend of absolute and relative elements in any PLI-setting exercise. We have already noted that the headline US$1-a-day international PLI was based on the lowest ten poverty lines among a set of low-income countries. In an analysis of the PLIs of 36 countries, Ravallion et al. (1991) found that the PLI tended to rise with the countries' average level of consumption per capita. The elasticity (at the mean) of the PLI with respect to consumption per capita was 0.7—a 10 per cent rise in consumption per capita leads to a 7 per cent rise in the adopted PLI. However the relationship they report is non-linear, so the elasticity was close to zero for low-income countries and closer to 1 for high-income countries.

In 2005 the 'absolute' PLI in the United States for a family of two adults and two children was US$19,806 a year—around ten times the international extreme poverty line of US$1 a person a day.[11] So even when policymakers are seeking to define an absolute PLI, their choice seems to be influenced by their country's average standard of living. It may be that Sen's '*capability*' is the underlying absolute concept, but the income or consumption levels needed to achieve it rise as countries develop. Sen defined poverty in terms of absolute standards of minimum material capabilities, recognizing that 'an absolute approach in the space of capabilities translates into a relative approach in the space of commodities' (1983: 168).

Absolute Poverty

Absolute standards for PLIs are commonly linked to nutrition and the resources to achieve an adequate diet. Food is clearly an important component in low-income countries where, by Engel's Law, the proportion spent on food can be large. Even in the US case, the PLI is calculated as three times the spending needed for an adequate diet as low-income US citizens spent around a third of their total spending on food when the PLI was first set.[12] This section reviews two widely used nutrition-based approaches to selecting the absolute PLI: the food energy intake (FEI) method and the cost of basic needs (CBN) method. The 2005 Malaysian PLI broadly follows the second of these approaches.

Food Energy Intake Method

The FEI approach has been widely used, in part because of its practical appeal.[13] Indeed, Ravallion and Lockshin (2003: 7) suggest that it 'is probably the most common method found in practice in developing countries'. A survey is used to measure (a) the actual per capita calorie food energy intake of each household; and (b) the household's total income (or expenditure) per capita. The relationship between the FEIs and household income is established by a simple statistical regression[14]—a line is fitted with FEI on the vertical axis and income on the horizontal axis. Such a relationship is shown in Figure 1.1. Medical and nutritional experts set a calorie requirement for individuals to lead a healthy and active life.[15] This requirement is labelled k in the figure. The PLI is then defined simply as the income level that, in our sample of households, is (in expectation) associated with k. The PLI is labelled z in the figure.

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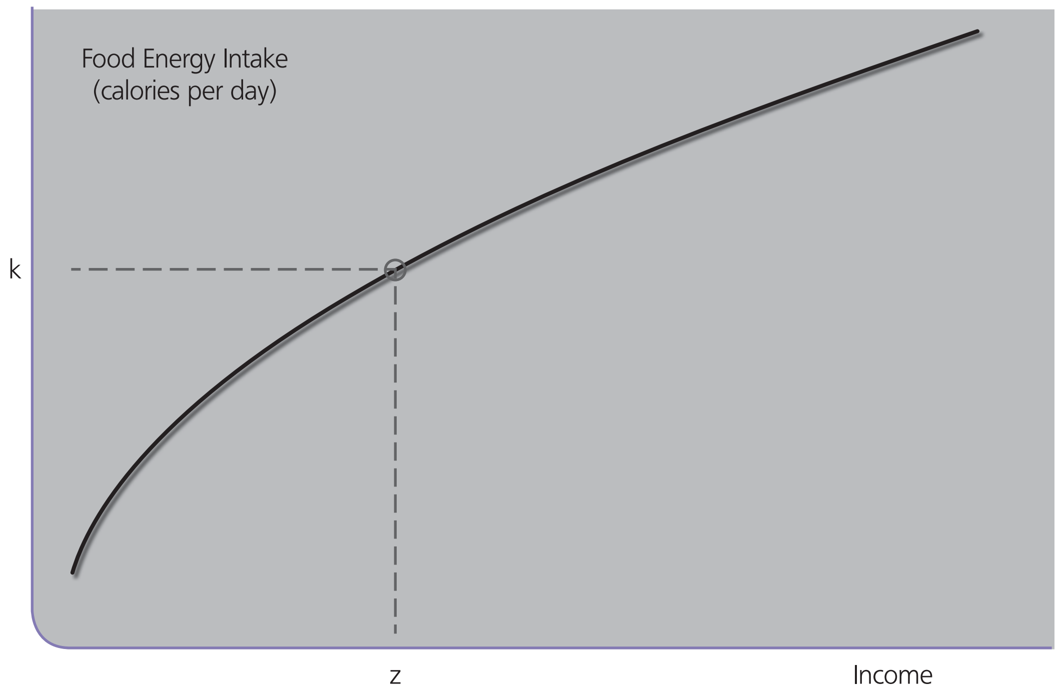
[11] Allowing for inflation, the 1993 US$1-a-day standard for a family of four was around US$2,000 per annum in 2005.
[12] The fact that the food share is now substantially lower than one third even amongst the poorest households is one important criticism of the US PLI.
[13] Good examples of this method are Greer and Thorbecke (1986) and the more recent Palmer-Jones and Sen (2001).
[14] The relationship may be non-linear, so appropriate regression techniques are required.
[15] As we shall see, calorie requirements will vary with age and sex, and possibly by location (rural individuals often require more energy than urban and people living in cold climates require more calories than those in tropical climates). For simplicity, we ignore these variations in nutritional requirement but clearly they will be important in any practical application of the FEI method.

The FEI method has two big advantages. First, it automatically takes into account non-food spending. Secondly, the method is computationally simple. A common practice is to set the PLI equal to the mean income or expenditure of a subsample of households whose actual caloric intakes are approximately equal to the stipulated requirements. More ambitiously, others have used statistical regressions of the empirical relationship between food energy intakes and consumption expenditure.

FIGURE 1.1 **Food Energy Intake PLI**



Because it is based on actual food consumption, the application of FEI can lead to some anomalous results, as Ravallion (1998) and Ravallion and Lokshin (2003) point out. Imagine calculating a PLI for two regions of a country where food prices differ, for example, rural and urban areas. Consider the case where non-food prices in the rural area are higher than those in urban areas but food prices are the same. Our natural expectation would be that the rural PLI would be higher than the urban PLI. But consider the case where food and non-food items are substitutes, so the higher rural non-food prices would lead rural households to switch their spending from non-foods into food. Rural households would thus reach the required caloric intake at a *lower* level of total spending and the PLI for the rural households would be lower than urban despite the fact that they face higher prices.

Now consider the case where prices are the same in the two regions, but urban households have different tastes—they may eat out more or prefer more expensive ways of achieving the target caloric intake. To reach the required energy intake they will require a higher income, and, as Ravallion and Lokshin (2003: 9) argue, it 'is unclear why we would deem a person who chooses to buy fewer and more expensive calories as poorer than another person at the same real expenditure level'.

Cost of Basic Needs Method

These anomalous features of the FEI approach naturally lead to the second nutrition-based PLI approach, the CBN method. This method identifies a consumption bundle deemed to be sufficient to meet basic consumption needs and then estimates the cost of purchasing (or 'prices up') such a bundle.[16] Two interpretations of CBN are possible: the first is based on household 'utility' (the welfarist approach discussed earlier) and the second is based on a socially determined definition of poverty. In the second CBN approach, a person may be considered as poor in state A and not in state B even if the s/he *prefers* state A to state B. So the leisure-loving individual discussed earlier would be classified as poor even when s/he chooses so to be.

In practical applications of the CBN approach, a person is deemed to be poor not if s/he has insufficient consumption of *each basic need*, but if s/he lacks the resources to purchase the *total bundle* of such needs. So, for example, we might identify basic food and non-food needs and arrive at a cost of achieving both. The PLI is then defined as their sum. An individual is not deemed to be poor if s/he consumes less than (say) the food basic need, because s/he could achieve it with an appropriate reallocation of her/his budget. In this way an individual might *prefer* a mix of food and non-food that puts her/him in the poor category to one that meets the CBN threshold.

However, in deciding on the food and non-food bundles, preferences of households are usually taken into account in practice. One could, for example, decide the cost of achieving an adequate diet by calculating the cost of the cheapest possible foods that deliver the required levels of calories. But such a food basket may lack any consumer appeal and it would be unreasonable to expect even poor households to buy it. As early as 1945, the American economist George Stigler discovered that, when costing a 'subsistence diet', it was important to take account of factors other than simple caloric content: flavour and variety are obvious additional characteristics people expect of food. So the cheapest way to consume the target calories may not be one that anyone would wish to purchase. In this way consumer preferences are nearly always recognized, even when PLIs are being drawn up to meet socially determined basic needs. This is broadly the approach adopted in the construction of the Malaysian 1977 and 2005 PLIs.

Ravallion's Lower and Upper Bounds

Ravallion (1998) proposes upper and lower bounds when setting the PLI, bounds that reflect the preferences of different groups of households. He first explains a method of deriving a food PLI (F-PLI) that is utility-consistent—the cost of a bundle of foods that is consistent with household preferences but one that meets the medically determined caloric requirement. Even in the construction of the F-PLI, there are likely to be limits to the role of preferences when the F-PLI is based on a socially determined norm. Imagine, for example, that a large number of households choose an unbalanced diet which has potentially damaging effects on health and/or life expectancy. Should the F-PLI simply reflect these preferences or should the balanced diet that delivers the energy requirement also be influenced by medical and health criteria? When faced with such a choice, most governments would base the F-PLI on

[16] This was the basis of Rowntree's original pioneering work (1901) on poverty in York in 1899.

a basket that delivers a healthy mix of protein, carbohydrate, and fat rather than one that is 'utility-consistent'.

For the non-food PLI (NF-PLI), there is little or no 'science' to apply in contrast to the nutritional basis of the F-PLI. So governments are more inclined to base the NF-PLI on items actually chosen by households. The question arises as to which households reveal most about non-food *basic needs*. Ravallion's approach is to define lower- and upper-bounds for the non-food component (NF-PLI). *For the lower bound*, the NF-PLI is based on the expenditures of households whose *total* expenditure is close to the food PLI. In the case of the *upper bound*, the NF-PLI is based on the spending of households whose *food* spending is close to the food PLI.[17]

Ravallion argues that the lower-bound approach is based on two assumptions:

- Once survival needs have been satisfied, as total expenditure rises, basic non-food needs will have to satisfied before non-survival basic food needs. These non-food needs are the prerequisites for members of the household to participate in society.
- Both food and non-food items are normal goods once survival needs are satisfied.

Ravallion contends that the non-food spending of households with income just sufficient to meet the F-PLI (lower-bound) must be on the really essential non-food items. The preferences of these households can be viewed as helping to identify the *basic needs* spending on non-food goods and services. The non-food spending of households whose *food* spending is close to the F-PLI would naturally be a more generous basis for the NF-PLI. There is, of course, no guarantee that Ravallion's upper-bound households actually consume the appropriate food bundle even though their food expenditure actually matches the F-PLI.

The Ravallion approach thus offers a *PLI range*: the lower bound is based on a less generous non-food component than the upper bound.

Relative Poverty

Many countries have explicitly defined poverty in relative terms. The most common approach is to define the PLI as *x* per cent of the country's median or mean level of income. For example, the Council of Ministers of the European Community recognizes someone as poor if s/he is a member of a household whose income per adult equivalent is less than half the national average. The choice of $x = 50$ per cent is admittedly arbitrary, but at least its arbitrary nature is made open and explicit. A similar approach has been adopted in Canada. The use of this measure implies that, if economic growth leads to equi-proportionate increases in everyone's income, the poverty rate will be unchanged even though poor individuals are getting richer.

Although this relative PLI will rise as the country enjoys favourable economic growth, it is nevertheless possible for the incidence of poverty to fall to zero if no one in the economy earns less than *x* per cent of the mean. The relative approach formally recognizes the general tendency for absolute definitions of poverty to increase with the overall standard of living.[18]

[17] The State Statistical Bureau of China has adopted this upper-bound approach.
[18] Atkinson and Bourguignon (2001) argue that a relative view of poverty, based on the country's own living standards, is something that only becomes relevant once absolute deprivation has been dealt with. For the poorest nations, the international standards are more relevant.

Subjective Poverty Lines

A natural way to define poverty is to ask individuals or community leaders to identify which households they consider to be poor. A participatory rural assessment (PRA) is a method often used by non-governmental organizations (NGOs) to assess the extent of poverty. The observer sits with the villagers and finds out about the village—its houses, school, water supply, and who lives where. In these exercises the observer will often ask the villagers to identify those who are poor. In most cases, villagers will have no difficulty in making an accurate identification. In India, for example, the Antyodaya food programme relies on local councils to identify the poorest people who then receive food rations. In Malaysia, during the National Development Policy period (1991–2000), the Development Programme for the Hard-core Poor (Program Pembangunan Rakyat Termiskin or PPRT) established a register on the profile of very poor households. At the state level, each village committee identified the hard-core poor and proposed the form of assistance suitable for the target subjects. Although these approaches will be useful in identifying individuals in urgent need of support, they often do not apply consistent criteria for poverty and their scope is often geographically limited. At best, they provide a fragmented picture of the extent of poverty and they are a poor basis for quantitatively setting the PLI. As some NGOs have discovered, if they use the poverty identification to enrol people into employment or training schemes, 'then after a few visits *everyone* is reported as poor' (Deaton, 2006).

Subjective assessments of the poverty line have recently been more formally investigated. It is possible quantitatively to arrive at a PLI by asking, in a sample survey, the following simple question: 'Is your current level of income adequate for your family's needs?'. Pradham and Ravallion (2000) implement this method using household surveys in Jamaica (for 1993) and Nepal (1995/6). They find that the aggregate poverty measures implied by the subjective poverty lines accord quite closely with existing 'objective' methods for both countries. Ravallion and Lokshin (2002) investigate subjective PLIs in Russia but they find that the objective poverty measures for Russia do not match well with subjective perceptions of who is 'poor'. Using survey data from Malawi, Ravallion and Lokshin (2005) investigate whether individuals perceive poverty in absolute terms, or in terms of comparisons with friends and neighbours (relative poverty). They find that relative deprivation was not a concern for the majority of their sample although it appeared to matter to the comparatively well off.

In a related area, participatory poverty assessment (PPA) collects poor people's views regarding their own analysis of poverty and the survival strategies that they use. PPAs have led to a greater understanding of the multidimensional nature of poverty and they are an effective tool for obtaining direct feedback from the poor on a country's poverty profile and the impacts of policy reform. However, they have not been used systematically to take poor individuals' view on the level of the PLI.

The United States illustrates in an interesting fashion a number of the issues raised in this chapter. Formally, the US government has adopted a nutrition-based absolute poverty definition, originally developed in 1963 and 1964 by Mollie Orshansky, an economist working for the US Social Security Administration.[19] Since 1946,[20] the Gallup Poll in the United States repeatedly asked the following question: 'What is the smallest amount of money a family of

[19] See Orshansky (1963).
[20] The question has not been asked since 1986 when Gallup moved from face-to-face to telephone interviewing.

four (husband, wife, and two children) needs each week to get along in this community?' The average response to this 'get-along' question has been consistently higher than the official absolute poverty line. Moreover, the answers have risen over time along with income, tracking half the median income in a fashion similar to the EU official PLI. Of course, this may only illustrate how subjective views of 'getting along' may differ substantially from more objective minimum standards of living based on basic needs.

To summarize: even when adopting 'absolute' measures of poverty, richer countries tend to adopt higher absolute standards when defining poverty. The United States is somewhat exceptional amongst developed countries in its commitment to an absolute PLI. More commonly, developed countries follow the European Union in formally linking their PLIs to the average standards of living of all citizens. Malaysia is currently ranked towards the top of the middle-income countries. In 2003 its gross national income per capita was US$8,940 (PPP measure), nearly twice that in the Philippines and half that of Portugal. Its economic transformation has been sufficient to lead to an upward revision in its PLI, but the Malaysian government is still concerned to monitor the incidence and intensity of poverty defined by absolute basic needs standards. The much improved economy-wide standard of living has been taken into account by raising the threshold PLI in its 2005 revision.

Food Share and Poverty

The share of total expenditure devoted to food is often seen as a key indicator of poverty. Like other non-luxury goods, the budget share devoted to food usually decreases with real total expenditure—a feature known as 'Engel's Law'. There are a number of problems with using food share as an indicator of poverty: it will vary with household composition (children normally need less food than adults) and it will also vary with food prices faced by the household. Nevertheless food share is a useful supplementary indicator of deprivation.[21]

The following relationship between the share of food spending in total expenditure (*fs*) and the log of the households per capita total expenditure was derived from the 2004 Malaysian Household Expenditure Survey:

$$fs_h = \underset{(0.012)}{0.944} - \underset{(0.002)}{0.096} \log(x_h) + e_h$$

where fs_h is the food share in the budget of household h; X_h is the household's expenditure per person; and e_h is the equation error term.[22]

[21] Ravallion and Huppi (1991) report that their food share data gave the same qualitative conclusions in comparing poverty over time and sectors in Indonesia as did consumption and income data.
[22] The equation was obtained by weighted least squares regression.

In the left panel of Figure 1.2, we graph food share against log spending, each scatter point representing one of the 13,933 households in the survey.[23] The linear relationship between food share and expenditure (given in the equation above) is also shown in Figure 1.2. Although there is a statistically significant decline in food share as total expenditure rises, there is considerable variation across households.

Of course, the relationship between food share and expenditure may not be linear. Indeed we might well expect the food share of the poorest households to be much higher than the simple linear model predicts, and to decline far faster as the household increases its spending on non-food items. Using the Lowess statistical procedure,[24] we fit a non-linear function to the scatter points and graph it as 'Lowess' in the right panel of Figure 1.2. The Malaysian expenditure data supports our expectations: the food share for the poorest households is higher than the simple linear relationship implies and it does decline more rapidly as spending rises from these low levels. Eventually, the non-linear relationship matches the linear one and the decline in the food share becomes more uniform. The graph could be used to help identify the PLI: it is the level of total spending at which the rate of decline of the food share becomes independent of spending. The vertical dashed line is the log of Malaysia's average 2005 PLI—expressed in per capita terms (RM166) and it is in the region of the graph where the rate of decline of the food share becomes independent of total spending.

Key Issues for Poverty Measurement

Other key issues that arise when defining and measuring poverty include the following:

- Income versus Consumption Data;
- Surveys versus National Accounts;
- Household versus Individual Data;
- Snapshot versus Time Line; and
- The Micawber Problem.

Income versus Consumption Data

There is general agreement that *monetary income* or *consumption* is only one of many dimensions of poverty. Many goods and services and many basic needs are provided at the community level or by government: health, education, and sanitation are obvious examples. Someone can have sufficient resources to buy essential *market* goods and services but live in an area with poor sanitation services or live in fear of crime. Nevertheless, income is the central dimension. It forms the basis of simple, numerical measures of poverty that should give clear, unambiguous information about poverty trends. Hence, in Malaysia, successive five-year plans[25] have reported the proportions of poor households using income data from regular Household Income Surveys (HIS). In that single, simple incidence statistic, a clear picture emerges of the success of policies aimed at reducing poverty. Measures based on income or consumption will inevitably form the core of any poverty analysis.

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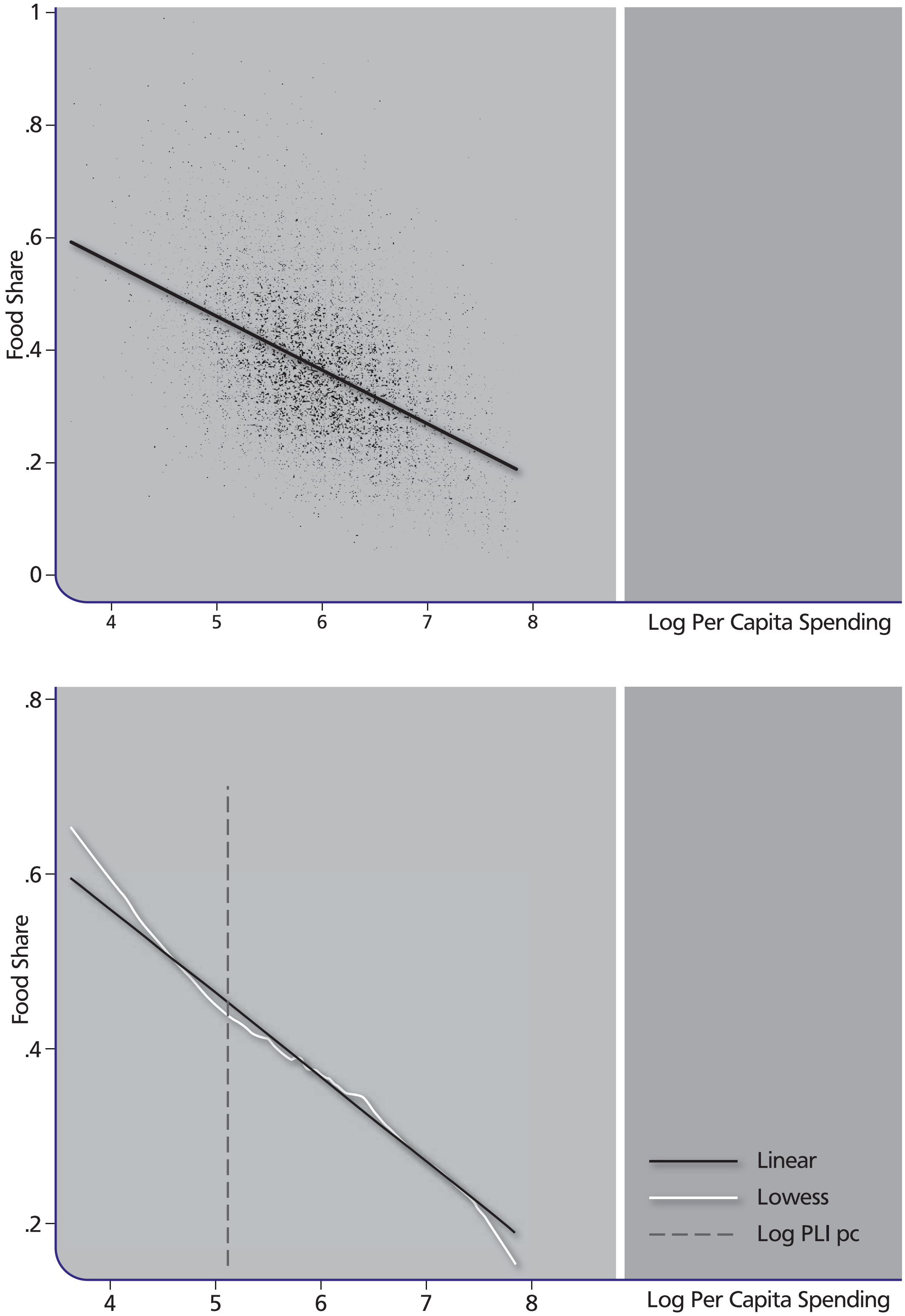
[23] We omitted the top percentile to avoid outlier effects. The full sample consisted of 14,074 households.

[24] Lowess is a statistical procedure used to capture non-linearities in relationships. At each point in the dataset, a low-degree polynomial is fitted to a subset of the data, with explanatory variable values near the point whose response is being estimated. The polynomial is fitted using weighted least squares, giving more weight to points near the point whose response is being estimated and less weight to points further away.

[25] See EPU (1976 and following years).

FIGURE 1.2 **Food Share: Malaysia, 2004**



In the Malaysian case, poverty is based on comparisons of household *income* with the PLI. A case has been made for using *consumption* rather than income when measuring poverty. Typically, income shows more transitory variation over time and it makes little sense to consider a household poor if its income only temporarily falls below the PLI. Young individuals often have low incomes while they acquire essential skills through education or on-the-job training. Having acquired these skills, their 'life-time' income is assured. By a life-time income criterion, such individuals are not poor but if, in an income survey, we sampled them when they were young, we might count them amongst the poor. Similar issues arise with households whose income is highly seasonal. The income of households engaged in farming might well fall dramatically in some months and if they are sampled in those months they might well be thought poor even when their annual income is well above the PLI.

Seasonal fluctuations in income have led some to prefer the use of consumption rather than income when identifying poor households or individuals. Economic theory predicts that consumption spending will be far smoother than income, reflecting the household's 'permanent' (or average) income. However, the ability to borrow in lean years against the promise of better times to come is very limited, particularly in developing countries. The advantages of using consumption are lost if it closely follows income because of income constraints.

Measurement issues also influence the choice of income or consumption as the basis for poverty measurement. There are fewer sources of income than there are items of spending, so income recall may be more accurate than consumption recall. Expenditure surveys using diaries may overcome this problem. On the other hand, income is notoriously under-reported. But as this is more likely to occur at the top end of the distribution, it is unlikely to have a major effect on inequality measures based on incomes at the bottom end of the distribution.

In the Malaysian case, Household Income Surveys are conducted on a regular basis whereas expenditure surveys are conducted less frequently. Moreover, the Household Income Survey contains rich information about each member of the household, information typically not available in expenditure surveys. Knowledge of each member's characteristics may help in analysing the causes of poverty rather than simply measuring its incidence or severity. For these reasons, poverty analysis in Malaysia is based on household income.

Surveys or National Accounts

Household surveys (of either income or consumption) usually form the basis of poverty analysis. The incidence of poverty is measured by the fraction of surveyed households (or individuals) with incomes below the PLI. The approach may be problematic if the survey is in some sense unrepresentative. Typically, the mean income and expenditure in household surveys are below those implied by the country's national accounts. Deaton (2003) reports that mean consumption from households surveys averages 86 per cent of national accounts consumption. For this reason, some have argued that the World Bank has overestimated world poverty by failing to take account of the national accounts controls. As the national accounts are based on a wide range of data sources, including the household surveys themselves, they are thought to provide a better estimate of mean income than surveys, even when the sampling frame is carefully constructed. There are many possible reasons why survey data may be inaccurate. Non-response rates and under-reporting are more common amongst richer households, so the sample mean will be downwardly biased. There may also be measurement problems at the bottom end of the distribution: for example, the poorest individuals may not be covered in surveys (vagrants, institutionalized persons, etc). The evidence from developed countries seems to indicate that it is the rich rather than the poor who are likely to be missed from income surveys,[26] a feature that is likely to carry over to other countries.

For this reason, some have argued that it is necessary to revise the survey data to make the unit records consistent with the national accounts. The simplest way to do this would be to adjust each household's income record by the ratio of the national accounts control to the sample mean. Of course this crude approach takes no account of the fact that the survey mean may understate the true figure because of distortions at the upper end of the distribution rather than because all incomes were proportionately under-reported. Despite these obvious weakness, the approach has been used to measure the incidence of world poverty by Bhalla (2002), who controlled to national accounts consumption, and Sala-i-Martin (2002), who used GDP controls. Unsurprisingly, by shifting the entire survey distributions to the right, the proportions of individuals with incomes below the international standards are dramatically reduced. As Deaton (2003) points out, 'according to these procedures, the poverty MDG has already been met'.[27] In this paper, Deaton makes a strong case for the use of survey data in measuring poverty and expresses the view that 'data from the national accounts are not suitable for measuring poverty'.

Before analysing poverty using Malaysia's Household Income Surveys, a comparison is made between the survey mean and the control given in the national accounts. The Department of Statistics (DOS) Malaysia reports National Income in 2004 to be RM425,603m, or RM1,386.45 per capita.[28] Applying a ratio of household income to national income of 49 per cent (based on 2002 figures), the national accounts estimate for household income per capita in 2004 is RM688.3. The mean income per capita in the 2004 Household Income Survey (HIS) was RM718.9, just 4.4 per cent above the national accounts control. This suggests that the HIS is a suitable data set on which to base our analysis of Malaysian poverty.

Household versus Individual Data

Most experts agree that it is the well-being of *individuals* that is important to monitor. Yet, in most settings, the data used to monitor poverty are at the *household* level. In the Malaysian case, the Household Income Surveys and the parallel Labour Force Surveys contain a great deal of information about the household and its demographic structure. Within each household record, we know which members bring income into the household. But we know nothing about whether the spending of the household's pooled income is shared equally or equitably over household members: that is, the survey does not cover the *intra-household* distribution of income. For this reason, poverty is defined at the household level: the poverty rate is defined as the proportion of *households* whose incomes fall below the *household's* PLI. As later observed, poor households in Malaysia are typically the larger ones. This means that the proportion of poor *individuals* in Malaysia is likely to be higher than the proportion of poor *households*, and intra-household income inequality cannot be investigated using the HIS.

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[26] See Deaton (2003) and Groves and Couper (1998).

[27] Using national accounts controls, Sala-i-Martin reports that the US$1/day poverty rate has fallen from 20 per cent to 5 per cent over the last twenty-five years of the twentieth century. The US$2/day rate had fallen from 44 per cent to 18 per cent.

[28] The national accounts data are based on DOS (2006a, 2006b).

Snapshot or Time Line

In most countries, and Malaysia is no exception, poverty incidence is measured at a point in time. As we have already observed, poverty could more usefully be thought of as a state through which individuals or households may periodically pass. Younger cohorts may be poor at the early stages of their life cycle, while farmers may be seasonally poor. If there is what Jenkins has called 'bottom-end churning', in which people move in and out of poverty, it is very important to understand something of *poverty dynamics*. Longitudinal or panel surveys are required for this purpose, though some indication of chronic or long-term poverty can be gleaned from the use of deprivation indices such as those pioneered in Ireland.

The Micawber Problem

All attempts to define poverty are subject to what Angus Deaton has called the 'Micawber Problem' (Deaton 2006). Wilkins Micawber was a character in the Charles Dickens novel *David Copperfield*. His dictum was 'Income twenty shillings, expenses nineteen shillings and sixpence—result happiness. Income twenty shillings, expenses twenty shillings and sixpence—result, misery'. As Deaton argues, 'One of the reasons Mr Micawber's observation is so memorable is that it is nonsense. Why should everything depend on such a tiny difference?' Deaton explains further: 'And why do we say that someone who is just below the poverty line is poor, and thus a candidate for transfers and the special attention of the World Bank, while someone who is just above it, whether by sixpence or by six annas, needs no help and can be safely left to their own devices? Even if we could precisely set the poverty line, and even if we could precisely measure each person's income, neither of which conditions are close to being met, it makes no sense to treat such similar people so differently.'[29]

The evolutionary biologist Richard Dawkins sees poverty lines as 'impositions of the discontinuous mind'—the tendency to view the world in distinct groups. 'You can meaningfully express a family's poverty', he writes, 'by telling us their income, preferably expressed in real terms of what they can buy … But spuriously precise counts or percentages of people said to fall above or below some arbitrarily defined poverty *line* are pernicious' (Dawkins 2004: 315). This may overstate Deaton's Micawber problem. Using a simple criterion for poverty allows us to assess poverty trends in a single, simple index: the incidence of poverty.

However, reliance on a *single* PLI may tempt governments with little genuine interest in the welfare of the poor to engineer minor income adjustments either side of the PLI with apparently dramatic effects on the incidence of poverty. For this reason, it is good practice to adopt more than one PLI (as Malaysia has done) and to report poverty measures that go beyond the simple headcount ratio.

[29] It might be argued that when the poverty line is appropriately defined, there should (by definition) be a 'jump' in welfare as individuals cross the line (Ravallion 1996). In fact, no index of poverty has been devised that takes into account the possibility of such a jump. We later argue that the food share may give some clues on the location of the poverty line.

2 MALAYSIA'S POVERTY LINE INCOME

MALAYSIA'S POVERTY LINE INCOME

Our main aim in this chapter is to explain the methodology behind the calculation of the 2005 revised poverty line income (PLI) in Malaysia. Malaysia was amongst the first to commit itself to an official poverty line. Introduced in 1977, the PLI has been used to measure poverty ever since. This chapter begins with a brief review of the methodology that lay behind the 1977 PLI before our coverage of the 2005 revision.

The Malaysian PLIs (both 1977 and 2005) are measures of absolute poverty. They are broadly based on the cost of basic needs approach described in the previous chapter. Both PLIs distinguish food and non-food components. Like many similar exercises in other countries, the food component is largely determined by 'objective' nutritional requirements. A 'Malaysian food basket' is defined that delivers a balanced, healthy diet. The cost of this basket defines the food component of the PLI. Household preferences are relevant in defining a suitable food basket—the food items have to be appropriate to Malaysian tastes. We will see that household preferences play a more important role in determining the non-food component as we based this on the actual non-food spending of Malaysian households who have sufficient income to afford a little more than the required food basket.

1977 PLI Methodology

In 1977, the Economic Planning Unit (EPU) introduced an absolute poverty line to enable policymakers to identify the poor and monitor their incidence.[30] This PLI was used to monitor poverty over the last quarter of the twentieth century. In estimating the food component of the PLI, the dietary requirement for a reference household of five persons was used. The rationale for using this 'model' household was the fact that the average household size in the 1973 Household Expenditure Survey (HES) was 5.4 persons. The composition of this five-person reference household is 1 adult male aged 20–39 years, 1 female adult aged 20–39 years, and 3 children of either sex with ages of 1–3 years, 4–6 years, and 7–9 years. The daily food intake requirement of the model household was then determined to allow for the estimation of the cost required to purchase a healthy and balanced diet. A food basket[31] was 'priced up', one that delivered 9,910 kcal and an additional 10 per cent was added on to the estimated total food PLI, where 5 per cent was to allow for condiments for the household and the remaining 5 per cent to allow a margin of safety. The food PLI estimated for a household of 5.4 persons in 1977 was RM160 or around RM30 per head.

For the non-food component, estimates for clothing and footwear for the model family of five were obtained from the Ministry of Welfare Services. The estimated monthly cost for clothing and footwear was RM 22.57 in 1977 prices. Other non-food expenditures considered included rent, fuel and power, furniture and household equipment, medical care and health expenses, transport and communication, recreation, education and cultural services. These components were based on the actual expenditures of households with monthly incomes less

[30] EPU (1978) documents the methodology adopted in the measurement of the PLI in 1977.
[31] The basket included rice, wheat flour, starchy tubers, sugar, pulses, vegetables, fish, eggs, milk, and cooking oil.

than RM200. Adding the food and non-food component, a PLI of RM252.36 was derived[32] and subsequently, the PLI has been updated annually to reflect the changes in the level of prices by taking into account changes in the consumer price index (CPI). Different PLIs were used for Peninsular Malaysia, Sabah, and Sarawak. Table 2.1 sets out the 1977-PLIs for selected years since 1990. The incidence of poverty was estimated using Household Income Surveys (HIS), which are conducted twice every five years. Households with incomes below the PLI were considered to be poor. [33]

TABLE 2.1 Poverty Line Incomes, 1990–2004

Area	1990	1995	1999	2002	2004
	*(RM per month per household)**				
Peninsular Malaysia	370	425	510	529	543
Sabah	544	601	685	690	704
Sarawak	452	516	584	600	608

* Based on an average household size of 4.6 in Peninsular Malaysia, 4.9 in Sabah, and 4.8 in Sarawak.

Over time it became apparent that the methodology used by EPU to calculate the incidence of poverty had some significant weaknesses. First, a substantial proportion of households in the HIS did not match the size and age distribution of the reference household. For example, a one-person household was classified as 'poor' if its income was insufficient to meet the food and non-food needs of the reference five-member household. And very large households could be misclassified as non-poor if their income were sufficient for the smaller model household. Averaging over all households meant that the 'headline' poverty headcount rate was informative. However, poverty profiles for subgroups with demographics that diverged from the reference household were potentially misleading. Secondly, the 1977 PLI did not allow for any spatial price variations across states and strata, other than to use different lines for Sabah and Sarawak.

There were two possible solutions to overcome these weaknesses. First, the implied *per capita* PLI for the reference household could be calculated (by dividing the PLI by five). Households would then be defined as poor if their income *per head* failed to reach the per capita PLI. This approach was adopted by Bhalla (1989). It permits somewhat more accurate poverty profiles, but it does not take into account variations in calorie requirements for households with varying age compositions[34] of members or the effects of household size

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[32] Another 5 per cent margin for safety was added to the PLI.
[33] When analysing poverty in 1970, Anand (1983) adopted a poverty line of RM25 per month per capita. Expressed in 1970 prices, the EPU poverty line would be RM30.6–around 20 per cent higher than that used by Anand.
[34] Households consisting of adults without children would require more calories than the per capita calorie requirements of the model household with three children.

if there are economies of scale.[35] Along similar lines the PLI could be expressed in *per adult equivalent* terms using an appropriate set of weights to reflect the age and sex composition of the household. The choice of equivalence weights in this case would be important. However, spatial variations in living costs are still ignored.

The second and preferred solution involves the calculation of a PLI for each household in the HIS (or HES)—a PLI that reflects the household's own demographics and location. This would lead to more accurate poverty profiles and enable policymakers to identify more precisely the characteristics of the poorest households. The revised methodology adopts this second approach.

2005 PLI Methodology

In the new methodology, a separate PLI is calculated for *each household* in the income survey—a PLI based on it size, composition, and location (state and stratum). As with the 1977 approach, the 2005 methodology distinguishes between food and non-food components of the PLI. We consider each in turn.

The Food PLI

The measurement of the food component is based on the dietary requirements of Malaysians. The energy requirement for each household is based on the sex and ages of its members. The advice of nutritionists, dieticians, and medical professionals from the Ministry of Health (MOH) and academia (Universiti Kebangsaan Malaysia [UKM] and Universiti Putra Malaysia [UPM]) was sought to ensure that the food PLI is able to meet the daily kcal requirement of Malaysians. The MOH (2004) details the energy and kcal requirements for Malaysia, distinguishing the three regions of Peninsular Malaysia, Sabah (including Labuan), and Sarawak. It also defines the food basket that will provide a balanced diet consisting of a variety of Malaysian foods which contain, overall, 10–20 per cent calories from protein, 20–30 per cent of calories from fat, and 50–60 per cent of calories from carbohydrate. The main categories in the food basket include cereal and cereal products (uncooked rice, wheat flour, and plain biscuits); meat (chicken), eggs and fish; milk (full cream milk powder and sweetened condensed milk); oil and fats (cooking oil and margarine, which are palm oil-based); sugar; vegetables, fruits, and pulses.

Table 2.2 sets out the daily calorie requirement of Malaysian males and females by age. The calorie requirements are based on adult male and female body weights of 60 kg and 50 kg respectively. The physical activity levels (PALs) for adult males and females are assumed to be identical, but younger males are assumed to have higher PALs than females of the same age. The required calories are delivered through Malaysian 'food baskets' set out in Table 2.3.

Two options are used: option 1 is for households with children under 7 years old, and the basket includes full-cream milk powder; households without these children are assumed to have a reduced milk powder diet (option 2). The food basket for households in Sabah/Labuan and Sarawak makes allowance for the absence of dhal in their diets.

[35] Some items of spending are lower in per capita terms for larger households: examples are housing and household durables.

TABLE 2.2 Recommended Daily Energy Requirements for Malaysians

Age Last Birthday	Body Weight (kg)	PAL	kcal/kg/day	kcal/day	MJ/day
Males					
0	7.7		85	650	2.72
1	11.5	1.45	82	950	3.97
2	13.5	1.45	84	1125	4.71
3	15.7	1.45	80	1250	5.23
4	17.7	1.50	77	1350	5.65
5	19.7	1.55	74	1475	6.17
6	20.7	1.55	73	1510	6.32
7	23.0	1.60	71	1630	6.82
8	25.7	1.65	69	1770	7.41
9	28.9	1.65	67	1935	8.10
10	32.3	1.70	65	2100	8.79
11	37.2	1.75	62	2305	9.64
12	41.3	1.80	60	2480	10.37
13	48.3	1.80	58	2800	11.72
14	53.1	1.85	56	2970	12.43
15	57.7	1.85	53	3060	12.80
16	59.0	1.85	52	3070	12.84
17	59.0	1.85	50	2950	12.34
18–29	60.0	1.75	43	2420	10.13
30–59	60.0	1.75	40	2385	9.98
60+	60.0	1.60	32	1900	7.95
Females					
0	7.2		83	600	2.72
1	10.8	1.40	80	850	3.56
2	13.0	1.40	81	1050	4.39
3	15.1	1.45	77	1150	4.81
4	16.8	1.50	74	1250	5.23
5	18.6	1.55	72	1325	5.54
6	19.9	1.55	69	1510	6.32
7	22.1	1.60	67	1630	6.82
8	24.7	1.65	64	1770	7.41
9	28.4	1.65	61	1935	8.10
10	32.9	1.70	58	2100	8.79
11	37.9	1.75	55	2085	8.72
12	43.1	1.75	52	2240	9.37
13	46.5	1.75	49	2280	9.54
14	48.6	1.75	47	2285	9.56
15	50.5	1.75	45	2270	9.50
16	51.7	1.75	44	2275	9.52
17	52.2	1.70	44	2300	9.62
18–29	50.0	1.75	36	1950	8.16
30–59	50.0	1.75	40	2025	8.47
60+	50.0	1.60	36	1800	7.53

Source: UKM/UPM/MOH.

TABLE 2.3 Alternative Malaysian Food Baskets

Food Item	Peninsular Malaysia Option 1* *Including Milk Powder*	Peninsular Malaysia Option 2* *Reduced Milk Powder*	Sabah/Labuan and Sarawak Option 1* *Including Milk Powder*	Sabah/Labuan and Sarawak Option 2* *Reduced Milk Powder*
Rice	0.102	0.102	0.102	0.102
Wheat Flour	0.020	0.020	0.020	0.020
Biscuits	0.010	0.010	0.010	0.010
Fish	0.025	0.025	0.033	0.033
Chicken	0.054	0.061	0.054	0.061
Eggs	0.026	0.032	0.026	0.032
Milk Powder	0.016	0.008	0.016	0.008
SCM	0.004	0.004	0.004	0.004
Oil	0.011	0.011	0.011	0.011
Margarine	0.004	0.004	0.004	0.004
Sugar	0.025	0.025	0.025	0.025
Vegetables	0.034	0.069	0.034	0.069
Fruit	0.057	0.057	0.057	0.057
Green Beans	0.006	0.009	0.006	0.009
Dhall	0.003	0.003		

Source: MOH (2004).
*Grams per calorie.

Given each household's specific calorie requirement (that is given its demographic composition), the total amount of grams required for each food item in Table 2.3 is calculated simply by multiplying each entry in the table by the household's total calorie needs. The food PLI is then calculated by multiplying the grams required for each food by its price. In Table 2.4 we present the specific foods (by Household Expenditure Code) that match the items listed in Table 2.3. These were selected to reflect the purpose of the exercise: viz., to calculate the required food expenditures of low-income households. If there was a choice of food quality, the lower price was selected. Thus for rice, we selected Standard B1 & B2 if available.

Given the prices of these food items by state and stratum, the price per calorie is calculated. There was surprisingly little variation in these food prices and the price per calorie showed little variation over states and strata as Table 2.5 demonstrates. Food prices in Kuala Lumpur and Sabah and Sarawak were higher than the other Peninsular Malaysian states.

Somewhat unexpectedly, the cost per calorie is higher in rural areas than in urban areas in eight states. The reason for this unexpected result is not clear: it may reflect the more competitive food retail markets in urban areas where hypermarkets may sell at lower prices.

Having calculated the price per kcal per day and each household's total calorie requirement, it is straightforward to compute the household's food PLI. In the 1977 measure, the food PLI was initially based on the cost required for a representative household of five persons to buy the food basket needed to meet such a household's energy requirements. In the 2005 approach, the food PLI for each household is calculated taking into account the household's size and composition. Daily kcal levels are converted to monthly kilocalories, which are subsequently multiplied by the price per kcal, and this defines the food PLI for each household.

The food PLI is now considered for each household so that poverty profiles are possible by household size, composition, state, and stratum—indeed by any household characteristic recorded in the HIS. The final food PLI is adjusted upwards by 5 per cent to allow for the cost of condiments.[36]

TABLE 2.4 Household Expenditure Survey: Selected Food Items

HES Code*	Item	Food Category	Unit	Grams
01103 (PM)	Rice: Malaysia Standard B1 & B2	Rice	kg	1000
01101 (EM)	Rice: Malaysia Super A1	Rice	kg	1000
01201	Wheat Flour	Wheat Flour	kg	1000
01304	Biscuits: Cream Cracker	Biscuits	350-500g	425
03205	Fresh Fish: Ikan Kembong, Pelaling	Fish	kg	1000
02117	Chicken	Chicken	kg	1000
04405	Hen's Eggs Grade C	Eggs	10	580
04310	Powered Milk: Everyday			1000
04314	Powered Milk: Everyday	Milk Powder	kg	900
04205 (PM)	Condensed milk: Tea Pot	Sweetened		
04206 (EM)	Condensed milk: Tea Pot	condensed milk	397g	397
05204	Cooking Oil: Vesawit	Oil	2kg	2000
05305	Margarine: Daisy	Margarine	500g	500
07101	Sugar: White Coarse Local	Sugar	kg	1000
06404	Sawi	Vegetables	kg	1000
06107	Papaya	Fruit	kg	1000
06505	Green Peas (Kacang Hijau)	Pulses	kg	1000
06508	Dhal (*PM* only)	Pulses	500g	500

Notes: *PM: Peninsular Malaysia; EM East Malaysia.

[36] We will, at a later stage of this paper, compare food PLIs for a typical five-person household located in various states and strata.

TABLE 2.5 Price per 100 Calorie in 2004 (RM)

	Urban		Rural	
State	Option 1	Option 2	Option 1	Option 2
Johor	0.134	0.140	0.131	0.137
Kedah	0.128	0.134	0.130	0.138
Kelantan	0.131	0.136	0.124	0.129
Melaka	0.132	0.139	0.131	0.136
Negeri Sembilan	0.130	0.136	0.135	0.143
Pahang	0.138	0.146	0.137	0.145
Pulau Pinang	0.133	0.141	0.133	0.142
Perak	0.132	0.140	0.132	0.141
Perlis	0.126	0.129	0.132	0.139
Selangor	0.134	0.141	0.136	0.143
Terengganu	0.137	0.146	0.140	0.147
Kuala Lumpur	0.142	0.149		
Sabah/Labuan	0.144	0.148	0.148	0.154
Sarawak	0.154	0.163	0.155	0.164

Source: DOS (Options defined in Table 2.3).

The Non-Food PLI

Determining and measuring the food PLI is relatively straightforward as it is based on the kcal or energy level required by each person in the household and the price per kcal. It is defined by the required nutritional levels of household members and the prices of the foods that meet these requirements given a 'standard' Malaysian food basket. For the non-food component, we adopt a revision of Ravallion's (1998) lower-bound case explained in Chapter 2: the non-food PLI is based on the expenditures of those households in the Household Expenditure Survey (HES) whose *total* expenditure was roughly 20 per cent higher than the *food* PLI.

The HES is conducted once every five years: the latest 2004/2005 survey is used in the construction of the non-food PLI. The main objective of the HES is to collect information on the levels and patterns of consumption expenditure by households on a comprehensive range of goods and services. The weights used in the construction of the Malaysian CPI are based on data gathered in this survey.

The mean food share of households in the 2004 HES whose *food* spending was close to the food PLI was 37 per cent. The National Steering Committee, which reviewed alternative approaches to measuring the PLI, thought this food share to be too low, so that in adopting Ravallion's upper bound, we would be overestimating the spending on the non-food component. The Committee favoured a modified lower-bound approach, in which the non-food requirements were based on the spending of households whose total spending was close to (within *x* per cent) of the food PLI raised by 20 per cent. This approach led to more generous non-food components than the strict lower-bound approach of Ravallion. The food share for these households in the HES was 50 per cent.

The choice of *x* is somewhat arbitrary: a low value means that the households we analyse have total spending very close to the adjusted food PLIs, but the total number of households may be too small for reliable estimates. A high *x* will increase the sample size but include households whose total spending is further from the adjusted food PLI.[37] We set *x* to be 20 per cent: this gave a sample size sufficiently large for the calculation of the non-food PLIs.

Household Size and the Non-food PLI

For non-food items other than housing, our first aim is to determine the amount of each item, *measured in KL 'numeraire' prices*,[38] that each person[39] requires to meet basic needs. For non-food item *i*, we define this as the constant, β_i. Notice that, because it is measured in KL prices, it does not vary over households: it represents the amount of money required to meet the relevant basic need if the household lived in KL. The individual's required expenditure on this item is expressed in local prices by multiplying by the relative 'local' price paid for the item. Finally, the *household's* PLI for the item is determined by multiplying the individual's required expenditure by the household size. For item *i* and household *j* of size N_j, we write the PLI component as

$$PLI_{j,i} = \beta_i \, N_j \, P_{j,i}$$

To estimate β_i it is assumed that the *mean* of the actual expenditures on item *i* across the selected households (i.e. those with total spending within 20 per cent of the adjusted food PLI) is equal to the *mean* basic needs over these households. Formally, β_i is defined to satisfy

$$\frac{1}{M}\sum_{j=1}^{M} P_{j,i}\, X_{j,i} = \frac{1}{M}\sum_{j=1}^{M} PLI_{j,i} \equiv \frac{1}{M}\sum_{j=1}^{M} \beta_i \, N_j \, P_{j,i}$$

where *M* is the number of households in the relevant subsample, $X_{j,i}$ is expenditure on item *i* by household *j* (in KL prices), and $P_{j,i}$ is the relative price of item *i* faced by household *j*.[40]

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[37] Chen and Ravallion (1996) use a non-parametric method which gives households closest to the food PLI a greater weight.
[38] We arbitrarily selected prices in Kuala Lumpur as our 'numeraire'. Nominal expenditures are deflated by the relative price of the non-food items in the state and strata of the household. We discuss these relative prices below.
[39] We do not distinguish the non-food needs for children differently from adults. In this respect, our approach to non-food needs differs from our approach to food.
[40] The prices faced by households depend on their state and stratum of residence.

β_i is thus obtained simply as

$$\beta_i = \frac{\sum_{j=1}^{M} P_{j,i} X_{j,i}}{\sum_{j=1}^{M} N_j P_{j,i}} \qquad [2.1]$$

The actual nominal expenditures (on item i) of the selected M households is totalled and then divided by the total number of household members 'weighted' by the relative price faced by household j for item i. The estimated β_i are set out in Table 2.6.

TABLE 2.6 Non-Food PLI Parameters

Item	β_i	α
Clothing	6.43	-
Housing	118.90	0.4745
Durables	3.90	-
Transport	11.61	-
Other non-foods	22.27	-

Economies of Scale

For housing, the possibility of scale economies raises further issues. Per capita rent and other housing costs for larger households are typically smaller than those for smaller ones. When calculating the PLI in the Russian context, Kakwani and Sajaia (2004) allowed for economies of scale in housing and clothing (the latter because clothing is often passed from older to younger family members) but they adopted ad hoc parameters to capture these scale economies.

Define $X_{H,j}$ to be the rent paid by household j expressed in Kuala Lumpur (KL) prices. Thus the rent actually paid would be $P_{H,j} X_{H,j}$, where $P_{H,j}$ is the rent paid by household j *relative* to that paid by households living in KL. It is natural to assume that $X_{H,j}$ rises with the number of household members in household j but not in proportion. In particular let

$$X_{H,j} = \beta_H \cdot N_j^{\alpha} + \varepsilon_j$$

where ε_j is a random error term, β_H is the rent paid by *single-member poor households* (again in KL prices), N_j is the number of members in household j and α is a parameter that captures economies of scale. If $\alpha = 1$, then there are no economies of scale: household rent is simply proportional to its size. If there are complete economies of scale, rent is independent of household size, so $\alpha = 0$.

We now have two parameters, β_H and α , to extract from the subsample of *M* households. Unfortunately, there were very few small households amongst the HES subsample. Indeed, there was only 1 single member household, paying a rent of RM56 per month. We therefore estimated β_H as the mean rent (expressed in KL prices) paid by single-member households *in the lowest quintile* (by per capita total expenditure). This was RM118.9 per month in the 2004 HES. Given this value for β_H , we derive an estimate of the economies of scale parameter α , from our subsample of *M* households with total spending close to the adjusted food PLI.

The contribution of housing to the poverty line for household *j* is therefore

$$PLI_{j,H} = \beta_H N_j^{\alpha} P_{j,H} \qquad 0 < \alpha < 1$$

where the '*H*' subscripts refer to housing. Our approach is to require that the mean rent across all *M* households is equal to the mean housing PLI component. Formally, this restriction is

$$\frac{1}{M}\sum_{j=1}^{M} P_{j,H} X_{j,H} = \frac{1}{M}\sum_{j=1}^{M} PLI_{j,H} \equiv \frac{1}{M}\sum_{j=1}^{M} \beta_H N_j^{\alpha} P_{j,H} \qquad [2.2]$$

Since β_H is known for housing, the restriction is satisfied through the selection of α .[41] The estimated values of β (in KL prices) and α are set out in Table 2.6. We estimate α to be 0.47, indicating substantial scale economies in housing.

To appreciate the implication of returns to scale in housing, consider the fact that a single-member household would require RM118.9 rent per month in Kuala Lumpur. A two-person household in KL would require RM165.2, less than twice that for a single-member, and a three-person household in KL would need RM200.3, considerably less than three times the single-member rent.

Non-Food Prices

To convert spending measured in KL ('numeraire') prices to those actually paid by households, relative price variations by state and stratum are taken into account. This section sets out the calculation of these non-food prices. The broad methodology is set out in the following steps:

1. We considered a subsample of the HES consisting of households whose per capita total expenditure is in the lowest quintile.[42]

2. At the six-digit level, we calculate the *quantities* purchased by each household in our subsample by dividing their nominal expenditures by the average price in their state/ stratum. Only those six-digit items that are both purchased by the lowest quintile and for which average prices are available for every state and stratum are considered.

[41] Non-linear numerical methods were used to obtain α.
[42] We initially considered only those households with total spending within 20 per cent of the adjusted food PLI, but the smaller sample substantially reduced the number of non-food items covered. We therefore extended the sample to cover the lowest quintile.

3. We averaged these quantities over all households in the sample, thus deriving the average quantities purchased at the six-digit level by the lowest quintile.

4. We multiply these averages by the state/strata prices to derive the cost of purchasing these mean quantities in each state/stratum. For example, the average quantity of sports shoes (HES code 032105) purchased by the lowest quintile in 2004 was 0.083. In urban Johor the average price of sports shoes was RM 50.71. So to buy the average quantity of sports shoes bought by Malaysia's lowest quintile would cost RM4.21 in urban Johor. In KL the price of sports shoes was RM75.93, so it would cost RM6.31 to purchase the average quantity in the capital. We do this for each six-digit item, and sum the product over the broader two-digit categories (e.g. clothing and footwear). So, in our example, all six-digit items starting with 03 are summed to obtain the cost of purchasing clothing and footwear in each state and stratum.

Using this approach, the non-food prices will reflect the *average spending patterns of Malaysia's low-expenditure households,* though it will not reflect any variations in preferences across states and strata.[43] The assumption is that for households at such low levels of spending, variations in spending patterns across states are likely to be of second-order as these households are simply meeting more basic needs.

The Department of Statistics (DOS) provided the two data sets required to calculate the non-food prices: expenditure at the six-digit level by the lowest quintile (defined by the level of per capita total spending) and average prices at the six-digit level for each state and stratum. There were some gaps in the price data—some prices were not always available, especially in rural areas. To ensure as wide a coverage as possible, missing prices were set at their equivalents in the other stratum.[44] We selected six digit items only if we had price data for them in every state and stratum and also if they were part of the lowest quintile's expenditure. The non-food prices were based on 106 items. The weighted sum of these prices within second-digit groups formed the price of clothing, housing, durables, transport and other non-foods.

In Table 2.7 we present the state/stratum weighted average prices of the broad non-food categories relative to those of Kuala Lumpur (the 'numeraire' price). The table reveals some significant variation in non-food prices across states and strata.[45] The costs of housing (rent, power, and fuel) are appreciably lower outside Kuala Lumpur, though those in Sabah/Labuan not substantially so. Indeed, the prices of most non-food items are substantially lower outside KL and, in general, non-food prices are lower in rural areas. These prices are used to calculate the non-food PLI—the amount of money required to meet non-food basic needs. The needs themselves are assumed to be the same across all states and strata, but because of price variation, the non-food PLI will, like the food PLI, vary by state and stratum.

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[43] The price index we use to deflate expenditures to their KL values is Laspeyres in spirit, since we apply the same quantity weights to the prices of each state and stratum. For an excellent discussion on the welfare implications of alternative price indices, see Deaton and Zaidi (2002), who show that the Laspeyres index is consistent with Samuelson's (1974) 'money metric utility' approach whereas the Paasche deflator is appropriate for the Blackorby and Donaldson (1987) 'welfare ratio' approach.

[44] These were typically items which rural households would normally purchase from urban areas. For example, rural prices were not available for motorcycles and similar durable goods.

[45] Informal perceptions of this variation lay behind the aim to make the PLI reflect variations in the costs of living across states and strata in Malaysia.

TABLE 2.7 Relative Non-Food Prices by State and Stratum, 2004

State	Clothing	Housing	Durables	Transport	Other
Urban					
Johor	0.906	0.589	0.941	0.841	0.757
Kedah	0.939	0.463	0.933	0.903	0.904
Kelantan	0.762	0.405	0.848	0.912	0.432
Melaka	0.924	0.547	0.886	0.914	0.860
N. Sembilan	0.887	0.518	0.942	0.904	0.756
Pahang	0.873	0.458	0.899	0.913	0.865
P. Pinang	0.869	0.695	0.901	0.918	0.870
Perak	0.859	0.462	0.894	0.916	0.682
Perlis	0.978	0.430	0.879	0.881	0.909
Selangor	0.783	0.739	0.899	0.912	0.874
Terengganu	0.838	0.468	0.913	0.890	0.537
Sabah/Labuan	0.900	0.882	0.919	0.938	0.768
Sarawak	0.948	0.613	0.923	0.890	0.763
Rural					
Johor	0.717	0.439	0.894	0.902	0.620
Kedah	0.699	0.369	0.854	0.873	0.735
Kelantan	0.774	0.326	0.816	0.861	0.415
Melaka	0.758	0.456	0.910	0.874	0.651
N. Sembilan	0.741	0.498	0.910	0.895	0.694
Pahang	0.789	0.418	0.918	0.854	0.576
P. Pinang	0.801	0.532	0.923	0.884	0.856
Perak	0.635	0.375	0.898	0.895	0.616
Perlis	0.680	0.390	0.860	0.840	0.548
Selangor	0.817	0.525	0.862	0.872	0.582
Terengganu	0.798	0.424	0.885	0.896	0.542
Sabah/Labuan	0.786	0.784	0.918	0.925	0.764
Sarawak	0.860	0.537	0.902	0.883	0.755

Note: KL Prices = 1.00.

PLI for the Representative Household

In order to compare the 2005 approach with that used before, we consider a reference household as close as possible to that adopted in the calculation of the 1977 PLI: one male adult and one female adult (both aged 18–29), two boys aged 3 and 9, and a girl aged 5.[46] The PLIs based on such a reference household are presented for each state and stratum in Table 2.8.

TABLE 2.8 **2005-based PLIs for the 'Model Household'* by State and Stratum, 2004**

	URBAN Poverty Line Income			RURAL Poverty Line Income		
State	*Food*	*Non-Food*	*Total*	*Food*	*Non-Food*	*Total*
Johor	380	331	711	373	274	647
Kedah	364	320	683	370	266	636
Kelantan	373	245	618	352	220	572
Melaka	374	335	710	372	282	653
Negeri Sembilan	368	316	684	382	298	680
Pahang	391	312	703	388	264	651
Pulau Pinang	378	373	751	378	326	704
Perak	374	292	666	375	254	630
Perlis	356	311	667	373	248	621
Selangor	379	381	760	384	292	677
Terengganu	389	276	664	398	263	662
Sabah	409	412	821	420	382	802
Sarawak	437	342	779	438	318	756
WP Kuala Lumpur	404	476	880			
WP Labuan	409	412	821	420	382	802

*Model Household: One male and one female (aged 18–29), two boys aged 3 and 9, and a girl aged 5.

The 1977-based PLI for a household of 4.6 members in Peninsular Malaysia was RM 543 per month in 2004. If we scale this upwards to reflect the needs of a five-member household, the 1977-based PLI is RM590. Similar scaling for Sabah and Sarawak resulted in PLIs of RM718 and RM633 respectively. The PLIs using the new methodology are higher in every state and stratum except for rural Kelantan, where the new PLI is about 3 per cent below the old. In the

[46] The calorie requirements behind the 1977 PLI were not sex-specific. For the 2005 methodology, the calorie requirements differ by sex as is clear from Table 2.2.

state with the highest cost of living, WP Kuala Lumpur, the new PLI is nearly 50 per cent higher than its 1977 level. In general, rural PLIs are substantially lower than their urban equivalents, except for Terengganu, where the rural PLI is only marginally below the urban value.

Chapter 1 noted (in Table 1.1) that the US$2-a-day international standard translated to RM136 per person per month in 2004. For our five-person household, taking no account of his demographic composition, the US$2-a-day standard for each individual requires a household income of RM680. In general, the 2005-based PLIs reported in Table 2.8 exceed this, though in some states (most notably Kelantan) lower than average prices give lower PLIs.

3 MEASURING POVERTY

MEASURING POVERTY

Chapter 1 reviewed different approaches that have been used to define the poverty line income (PLI) and Chapter 2 explained the methodology used in Malaysia's recent (2005) revision of its PLI. There are a number of ways of measuring poverty for any given poverty line. In this chapter, we explain the various indices of poverty and these are applied to Malaysia in Chapter 4.

The most commonly used measure is the 'headcount' ratio—simply the total number of poor households or individuals expressed as a ratio of the number of all households or individuals. This measures the *incidence* of poverty. But in the quarter of a century after Sen's (1976b) ground-breaking work on poverty measurement, more than a dozen new poverty measures have been proposed. These measures have their strengths and weaknesses and it is now generally accepted that a comprehensive account of poverty requires consideration of more than one single measure. This chapter considers a number of key indices of poverty, including some useful graphical methods of presenting the various dimensions of poverty.

Axioms of Poverty Measures

In the late 1970s, the Nobel prize-winner Amartya Sen challenged the value of the headcount ratio as a measure of poverty. His reasoning went as follows: imagine you take US$10 from a person who is far below the poverty line and by giving it to someone marginally below the poverty line, you lift the recipient out of poverty. In this example, the headcount measure of poverty will fall, since the recipient will cease to be below the poverty line. But such a transfer (from someone poor to someone better off) cannot be thought of as a poverty-reducing act. Sen set out a number of desirable properties or axioms that any measure of poverty should possess and his celebrated 1976 *Econometrica* paper (Sen 1976b) has had a profound impact on the way in which poverty is measured and analysed.

There are six essential (and reasonable) properties (or axioms) that poverty measures should possess.

Focus

The measure of poverty should not be affected by changes to non-poor incomes that leave the incomes of the poor unaffected.

Symmetry:

The measure should be unaffected if two persons switch incomes. This clearly implies that our measure requires 'anonymity'.

Population independence:

If two or more identical populations are pooled, the index of poverty should be unchanged.

Monotonicity:

A reduction in the income of a poor person should increase the index or measure of poverty.

Transfer:

A regressive transfer between two poor persons should increase the poverty index.

Increasing poverty line:
The index of poverty should be an increasing function of the poverty line income.

Evidently, these are reasonable properties that we would like our measures of poverty to possess. Kakwani (1980) additionally proposed a subtle variation on the monotonicity and transfer axioms, variations he called monotonicity-sensitivity and transfer-sensitivity. Under monotonicity-sensitivity, the poorer a household is, the larger should be the increase in the poverty index. Similarly, under transfer-sensitivity, the index should be less sensitive to regressive transfers between the poor as they become richer.

In many practical settings, we might additionally require

Decomposability:
If there exist non-overlapping and exhaustive subgroups in the population, aggregate poverty measures can be expressed as a weighted sum of the same index for the different groups. This property will permit the identification of which subgroups of the population contribute most to the overall index. This axiom is therefore one that is particularly desirable when the poverty measure is being used to guide public policies for poverty relief.

The decomposability property is one that will eliminate many indices that have been proposed but the key measures covered in this section have this property and this makes them particularly useful in practical policy settings.

P_α : A Key Class of Poverty Measure

One particular class of poverty measure has been widely used in poverty analysis—the so-called P_α index proposed by James Foster, Joel Greer, and Erik Thorbecke (1984) (FGT). The index is simply:

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{m}\left(\frac{z-y_i}{z}\right)^{\alpha} \qquad [3.1]$$

where n is the total number of individuals[47] in the population, m is the number of *poor* individuals, y_i is the income of poor individual i, z is the poverty line income (assumed, for convenience, to be common to all), and α is a coefficient that measures the 'aversion' to poverty. In most country applications of this index, α is set to 0, 1, or 2. Later in this section, we illustrate its calculation with a simple hypothetical example.

To appreciate intuitively how this measure works, we rewrite equation [3.1] as

$$P_\alpha = \frac{1}{n}\sum_{i=1}^{m}\left(\frac{z-y_i}{z}\right)\left(\frac{z-y_i}{z}\right)^{\alpha\text{-}1} \qquad [3.1a]$$

---

[47] For presentation purposes only, our discussion centres on the *incomes of individuals*. The analysis could also be applied to total expenditure (rather than income) and at the household level. However, when analysing households, account has to be taken of variations in their size and demographic composition.

The idea of this index is simple: it sums every poor individual's *relative* or *normalized* distance from the poverty line, $(z - y_i)/z$, weighted by the relative distance itself raised to the power α-1. For poor individuals, $(z - y_i)$ is positive, increasingly so as income falls. The relative or normalized value is derived by expressing this distance as a ratio of the poverty line income, z. The sum of this over the poor is then averaged over the entire population, n. As the aversion parameter α rises, more relative 'weight' will be given to the larger deviations from the poverty line. Parameter α may be interpreted as describing the policymaker's 'social welfare function'—high values of α may describe the preferences of policymakers with particular concerns for very poor members of society.

Usefully, the P_α index can be written as an aggregation over subgroups:

$$P_\alpha = \sum_j \left(\frac{n_j}{n}\right) P_{\alpha,j}, \qquad [3.2]$$

where n_j is the number of individuals in subgroup j (e.g. individuals living in different regions, or engaged in different professions, or schooled to different levels), and $P_{\alpha,j}$ is the P_α index covering only individuals within the jth group. This decomposition will be particularly useful when the index is used to inform policies directed at poverty relief.

We now consider three special cases of this index, cases that correspond to three different values for α: 0, 1, and 2.

P_0: the headcount ratio

When $\alpha = 0$, $P_0 = \frac{1}{n}\sum_{i=1}^{m}\left(\frac{z - y_i}{z}\right)^0 = \frac{m}{n}$ and the P_α index collapses to the headcount ratio—the number of poor individuals (m) expressed as ratio of the total population (n). This is the most commonly used poverty measure, its popularity being due to the fact that its meaning is intuitively obvious.

Despite its popularity, the P_0 measure violates the key axioms of monotonicty and transfer. If a poor person becomes poorer, the index is unaffected (violating monotonicity); and a transfer from a poorer poor person to a richer poor person leaves the headcount ratio unchanged (violating transfer). To use Jenkins and Lambert's (1997) 'three I's' terminology, the P_0 measure captures changes in the incidence of poverty, but not changes in its 'intensity' or changes in the 'inequality' of incomes amongst the poor.

P_1: normalized income gap.

When $\alpha = 1$, $P_1 = \frac{1}{n}\sum_{i}^{m}\left(\frac{z - y_i}{z}\right)$. This is the income gap ratio: we simply sum the normalized (or relative) difference between individual income and the poverty line and take the average over the whole population. This is sometimes referred to as the *per capita aggregate poverty gap*: the amount, expressed as a fraction of the poverty line, that each person in the population would have to contribute (under perfect targeting) to eradicate poverty. So, for example, if P_1 took the value 0.1, then poverty could be eradicated if every person 'chipped in' 10 per cent of the poverty line to a fund to be transferred to the poor.

Unlike the headcount ratio, this measure satisfies *monotonicity*—a reduction in the income of one poor person will raise the index (albeit fractionally). But the measure again fails to meet the transfer axiom: in particular, a *regressive* transfer from one poor person to another will leave P_1 unaffected, violating the transfer axiom. So a worsening of the distribution of income amongst the poor will not be picked up. Again, using the 'three I's' terminology, the P_1 measure captures changes in the *incidence* and *intensity* of poverty, but not changes in the *inequality* of income amongst the poor.

The P_1 measure can also be written as

$$P_1 = P_0 I \text{ where } I = \left(\frac{z - \bar{y}_p}{z}\right),$$

where $\bar{y}_p$ is the average income of poor individuals; I is the average normalized income gap amongst the poor.

A related poverty measure, which we shall use later in this section, is the simple per capita poverty gap defined as

$$\tilde{P}_1 = \frac{1}{n}\sum_{i=1}^{m}\left(z - y_i\right)$$

In this case, the income gap for each poor person is not normalized by dividing by z.

P_2: weighted income gap ratio

FGT proposed that the distance between individual i's income and the poverty line be weighted by the gap itself—so the bigger the gap, the greater the weight given to it in the poverty index. This means that $\alpha = 2$,

$$P_2 = \frac{1}{n}\sum_{i}^{m}\left(\frac{z - y_i}{z}\right)\left(\frac{z - y_i}{z}\right) = \frac{1}{n}\sum_{i}^{m}\left(\frac{z - y_i}{z}\right)^2 .$$

This index additionally satisfies the transfer axiom: a regressive transfer amongst the poor will raise the index of poverty, as the income of the poorer individual is given greater relative weight in the index. For this reason, this measure is sometimes referred to as a poverty *severity* index.

Amongst this broad 'FGT-class' of poverty measure, Sen's monotonicity axiom is satisfied only for $\alpha > 0$, the transfer axiom is satisfied only for $\alpha > 1$ and Kakwani's transfer-sensitivity axiom is satisfied only for $\alpha > 2$. To satisfy the transfer-sensitivity axiom, the weighting of larger income gaps should be greater than the income gap itself.

Calculation of P_α

Table 3.1 presents details of the calculation of the P_α indices for a hypothetical sample of 30 individuals.[48] In this illustration, the poverty line income (z) is assumed to be US$500 and individuals with incomes below this are deemed to be poor. Of the sample of 30, 6 have incomes below z (indicated by the highlighted rows). Note that individuals #16 and #17 have incomes that differ by only US$2 but #16 is non-poor and #17 is poor. The poverty indicator in column (3) of the table equals one if the individual's income is less than z and zero otherwise. Summing down the rows of column (3), we obtain the total number of poor—6 individuals or 20 per cent of the total sample (6 ÷ 30) per cent. To get a better idea of the *intensity* of poverty, we calculate for each poor individual the gap between their income and the poverty line. Equivalently for every individual i this is max(z-y_i , 0). Individual #17 is poor, but by only US$1; the poorest individual is #10 whose income of US$100 is US$400 short of z. Summing down the rows of column 4, we calculate the total 'income gap' (US$1,471), which averages just over US$49 per person over the full sample of 30 individuals. If everyone in our hypothetical economy (including the poor) chipped in US$49 to a central fund, there would be enough money to lift every poor person out of poverty in a perfectly targeted poverty relief programme.

Column 5 of Table 3.1 calculates the normalized income gap for every person—that is, their income gaps expressed as a fraction of the poverty line. Thus individual #7 is US$166 short of z, a normalized gap of 166 ÷ 500 or around 33 per cent. Summing down the rows of column 5 and dividing by the total number of individuals (poor and non-poor), we derive the P_1 index (0.098 or 9.8 per cent). If every individual 'chipped into' a central fund, 9.8 per cent of the poverty line, then these funds would be enough for a perfectly targeted poverty programme to lift every poor person out of poverty. To confirm this: 9.8 per cent of z is US$49, so the poverty relief fund would contain US$49 x 30 = US$1,471. The income gaps shown in column (4) could all be reduced to zero by an appropriate disbursal of the fund. When we weight the normalized income gap (by itself), we obtain the P_2 measure, as shown in column (6) of Table 3.1.

[48] When applied to *household* (rather than individual) income data, total household income is often expressed in per capita or per adult equivalent terms.

TABLE 3.1 **Hypothetical P_α Indices and Time Out of Poverty**

(1) Individual #	(2) Income (y) ($)	(3) Poverty Indicator = 1 if poor = 0 otherwise	(4) Income Gap max(z-y,0) ($)	(5) Normalized Income Gap max((z-y)/z,0)	(6) Normalized Income Gap Squared	(7) Time Out of Poverty (Years) $\gamma = 0.03$
1	1,115	0	0	0	0	0
2	1,583	0	0	0	0	0
3	775	0	0	0	0	0
4	720	0	0	0	0	0
5	835	0	0	0	0	0
6	771	0	0	0	0	0
7	334	1	166	0.332	0.110	13.45
8	1,106	0	0	0	0	0
9	878	0	0	0	0	0
10	100	1	400	0.800	0.640	53.65
11	2,191	0	0	0	0	0
12	622	0	0	0	0	0
13	658	0	0	0	0	0
14	571	0	0	0	0	0
15	921	0	0	0	0	0
16	501	0	0	0	0	0
17	499	1	1	0.002	0.000	0.07
18	999	0	0	0	0	0
19	698	0	0	0	0	0
20	550	0	0	0	0	0
21	1,663	0	0	0	0	0
22	1,061	0	0	0	0	0
23	150	1	350	0.700	0.490	40.13
24	704	0	0	0	0	0
25	692	0	0	0	0	0
26	312	1	188	0.376	0.141	15.72
27	843	0	0	0	0	0
28	682	0	0	0	0	0
29	134	1	366	0.732	0.536	43.89
30	1,164	0	0	0	0	0
Sum		**6**	**1,471**	**2.942**	**1.917**	**166.91**
Average over *all* individuals (Sum÷30)		$P_0 = 20\%$	$\tilde{P}_1 = 49.03$	$P_1 = 0.0981$	$P_2 = 0.0639$	$t(0.03) = 5.56$
Average over poor individuals (Sum ÷ 6)						$t^P(0.03) = 27.8$

[Poverty line (z) = US$500]

The failure of the poverty gap and headcount measures to satisfy the transfer axiom is helpfully illustrated by this example taken from the World Bank Development Report (1990). Imagine that we need to find out how an increase in the price of rice affects poverty in Java, Indonesia. Households close to the poverty line are, on average, net *producers* of rice, so the headcount index of poverty would typically fall when the price of rice increased, as some of these net rice producers 'crossed over' the poverty line, benefiting from the price rise. But the poorest amongst the poor are net *consumers* of rice and the rise in the price of rice would make them worse off—lowering their 'real' incomes. Poverty measures that take the severity of poverty into account would show an *increase* in poverty when the price of rice rises—exactly the opposite of the message conveyed by the headcount ratio. Even if the headcount ratio remained unchanged because the poor who benefited from the price rise were not lifted out of poverty, the income gap measure would also be unchanged despite the increase in inequality amongst the poor.

The Watts Index

An early poverty index proposed by Watts (1968) has also attracted recent interest. This index is defined as

$$W = \frac{1}{n}\sum_{i}^{m}\left[\ln(z) - \ln(y_i)\right] \qquad [3.3]$$

It satisfies the key axioms (including transfer) and, usefully, it is additively decomposable. Despite these desirable features, the Watts index was not widely used, probably due to the fact that it, too, has no cardinal interpretation. However, Morduch (1998) demonstrated that dividing the Watts index by a hypothetical growth rate, γ, defines the average period of time it would take for the poor to exit poverty if everyone experienced this growth in their incomes. Morduch noted that we could define the period of time for individual *i* to escape poverty as

$$t_j(\gamma) = \frac{\ln(z) - \ln(y_i)}{\gamma}$$

For example, consider the poorest individual #10 in Table 3.1 Her income is US$100, well short of the assumed poverty line of US$500. If her income were expected to growth by 3 per cent per annum, it would take:

$$t_j(\gamma) = \frac{\ln(z) - \ln(y_i)}{\gamma} = \frac{\ln(500) - \ln(100)}{0.03} = \frac{6.214608 - 4.60517}{0.03} = 54 \textit{ years}$$

for her to exit poverty (see column (7) of Table 3.1). For individual #7 with an income closer to *z*, it would take 13 years to escape poverty with 3 per cent growth. And for #17, her income after one year would be US$499 x 1.03 = US$514—well above *z* after only one year. Were the expected growth rate of income to be 5 per cent per annum, individual #10 would escape poverty in 32 years and individual #7 in 8 years. We can calculate the time it will take *each* person to exit poverty and compute the average time over all individuals, including the non-poor, for whom $t_j(\gamma) = 0$. This average exit time for the population is therefore

$$t(\gamma) = \frac{1}{n}\sum_{i=1}^{n} t_j(\gamma) = \frac{1}{n}\sum_{i=1}^{m} \frac{\ln(z) - \ln(y_i)}{\gamma} = \frac{W}{\gamma} \qquad [3.4]$$

For our hypothetical sample in Table 3.1, the average is 5.5 years. The average exit time for poor persons only, $t^P(\gamma)$, is easily obtained by dividing $t(\gamma)$ by the headcount ratio:

$$t^P(\gamma) = \frac{t(\gamma)}{P_0}$$

In our illustration, this is 5.5 ÷ 0.2 = 28 years.

To see how this index is sensitive to income distribution amongst the poor, consider the following simple two-person illustration. The assumed poverty line is US$500 and, initially, both individuals have identical incomes of US$300. Assuming an income growth rate of 3 per cent per year, it would take both approximately 17 years to escape from poverty, so, when averaging, we find $t^P(\gamma) = 17$. Now consider the case in which the two incomes are US$200 and US$400. In this case, the mean income of the poor remains at US$300 but income is *more unequally distributed* amongst the poor. An index that is sensitive to the severity of poverty should rise. The poorer person will take just over 30 years to exit poverty and the richer poor individual will escape poverty in only 7.4 years, an average of 19 years. Although the mean income of the poor is the same in both cases, the greater degree of inequality amongst the poor raises the average time out of poverty. Average time out of poverty has considerable appeal as a headline-grabbing statistic. And of course it stresses the importance of economic growth as a policy-alleviating mechanism.

Computing the value of a particular poverty index over a single distribution of incomes may convey important information. For example, policymakers are naturally interested in precisely what proportion of households currently lie below the poverty line. Typically, they will also be interested in *comparing* indices derived from different distributions. For example, policy makers may wish to compare poverty measures across different regions, or compare rural poverty with urban. And they would certainly like to know whether their poverty measure is rising or falling by examining income distributions from different time periods.

The poverty measures we have outlined thus far are all attempts to capture changes in the distribution of income in a single number, P_0, P_1, P_2, or $t^P(\gamma)$. Of course, thoughtful policymakers may well want to consider each of these and ensure that all are moving 'in the right direction'. In our Indonesian example (above), the P_0 improved but P_2 deteriorated—there were fewer poor households, but those that were poor were increasingly so. Faced with declines in P_0 but increases in P_1 and P_2, policymakers should not be complacent.

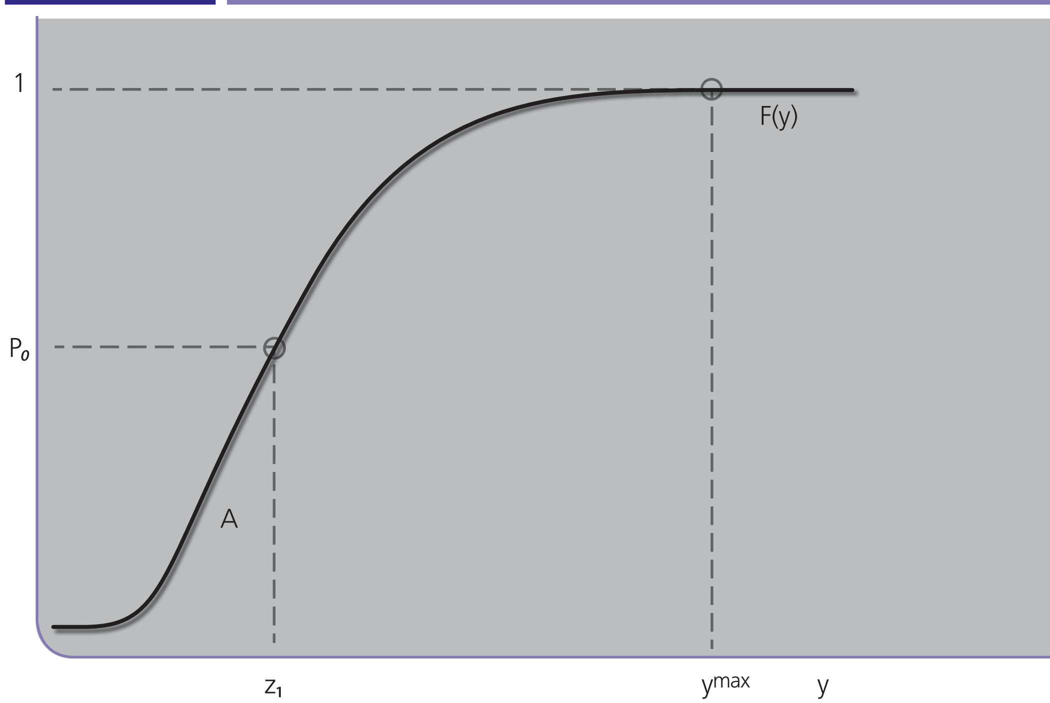
Graphical Devices

Rather than assessing the success of policies from the statistical measures discussed so far, recent contributions have proposed the use of *graphical methods*. This is an appealing approach, for, as Deaton (1997: 158) explains, 'the reduction of a distribution to a single number is perhaps a lot more aggregation than we want, and more fundamental insights into the levels of living can often be obtained from graphical representations of either the whole distribution or some part of it'.

CDF Diagrams

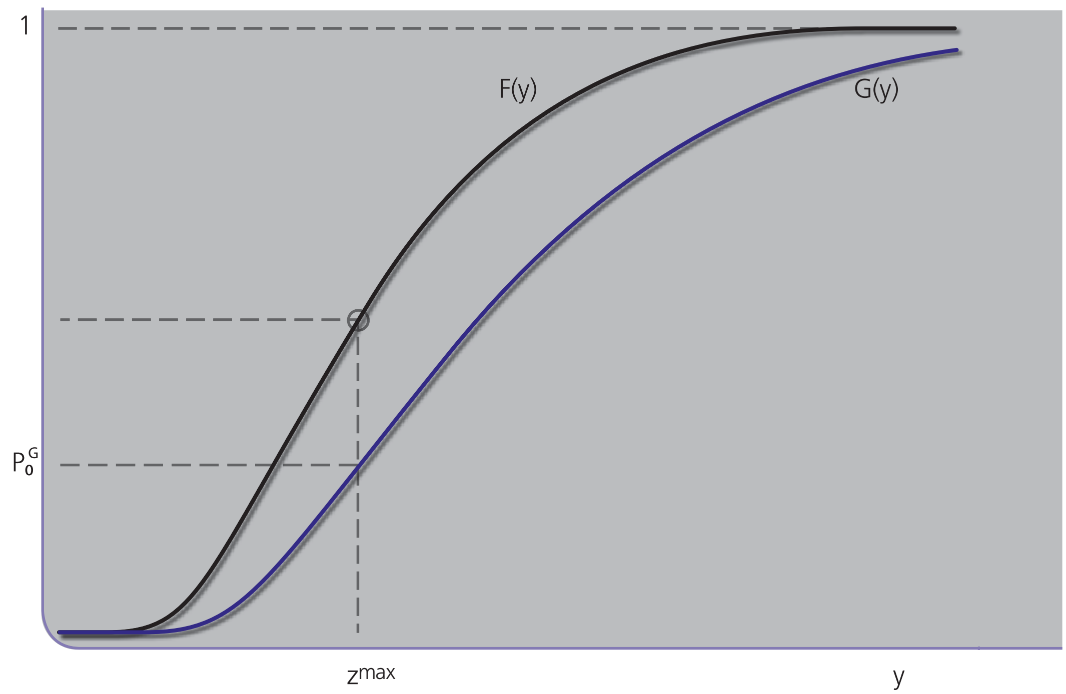
An obvious way to graph the distribution of income is the *cumulative distribution function* (CDF). This simply plots on the vertical axis the proportions of the population with incomes equal to or less than the income level indicated on the horizontal axis. Figure 3.1 presents an illustrative CDF labelled $F(y)$. Since $F(y)$ measures proportions, it lies in the interval {0,1} and reaches its maximum value at the highest income received, so $F(y^{max}) = 1$, everyone earns equal to or less than the maximum income. In poverty analysis, we are naturally only interested in the CDF at low levels of income. For any given poverty line, say z_1, the function $F(y)$ measures the headcount ratio (labelled P_0 in Figure 3.1)—the proportion of the population with incomes equal to or less than the poverty line. The CDF can be thought of as a plot of the headcount ratio as we vary the poverty line. It could therefore be called the *poverty incidence curve* (PIC).

FIGURE 3.1 **Cumulative Distribution Function (Poverty Incidence Curve)**



Consider a situation in which we wish to compare poverty incidence given two income distributions summarized by their CDFs, $F(y)$ and $G(y)$ presented in Figure 3.2. These may be distributions drawn for individuals in different regions of the same country at the same point in time or distributions drawn for all individuals over two different time periods. In the latter case, we might be interested in whether poverty incidence is improving or not. We might, additionally, be unsure about the precise location of the poverty line itself, but we know it cannot be greater than z^{max}. In Figure 3.2, $F(y)$ is assumed to be the CDF for an initial year and $G(y)$ is the more recent CDF. $G(y)$ is everywhere below $F(y)$. In particular, it is everywhere below $F(y)$ in the region of interest: income levels up to the maximum poverty line, z^{max}. This means that the headcount ratio has fallen over time, *regardless of the choice of poverty line*. Given a poverty line of z^{max}, the incidence of poverty will have fallen from P_0^F to P_0^G in Figure 3.2.

FIGURE 3.2 **First-Order Dominance**



What would the CDFs look like for the Indonesian example given earlier? In this case, the poorest individuals (rice consumers) were worse off and richer poor individuals (rice producers) were better off. The case is illustrated in Figure 3.3. The worsening position of the poorest means that had we selected a poverty line below z_1 the headcount ratio would rise; it would be observed to fall for all poverty lines between z_1 and z^{max}. Inspection of the two CDFs reveals Sen's problem with the headcount ratio: if the official poverty line were z^{max}, poverty would be said to fall despite the worsening position of the poorest members of society. This simple graphical device is therefore very informative. The case illustrated in Figure 3.2 is called 'first-order dominance'—we can say that the distribution *G*(*y*) *first-order dominates F*(*y*) because it lies below *F*(*y*) at each and every level of income. When used to analyse poverty, we only need to establish first-order dominance over the range of permissible poverty lines rather than over the entire distribution. With first-order dominance, we know that poverty is lower, regardless of the poverty line used. Even if we were confident of the position of the poverty line, say at z^{max}, constructing the two CDFs would immediately raise concerns when the worsening position of the poorest members of society is visually apparent.

There is no first-order dominance in the case illustrated in Figure 3.3 simply because the CDFs intersect. In such cases, we might wish to test for 'second-order dominance'. Second-order dominance compares the areas beneath the CDFs at all possible poverty lines below z^{max}. The area beneath the CDF has been called the *poverty deficit curve* (PDC) and its significance will be explained later.

FIGURE 3.3 **Intersecting CDFs**

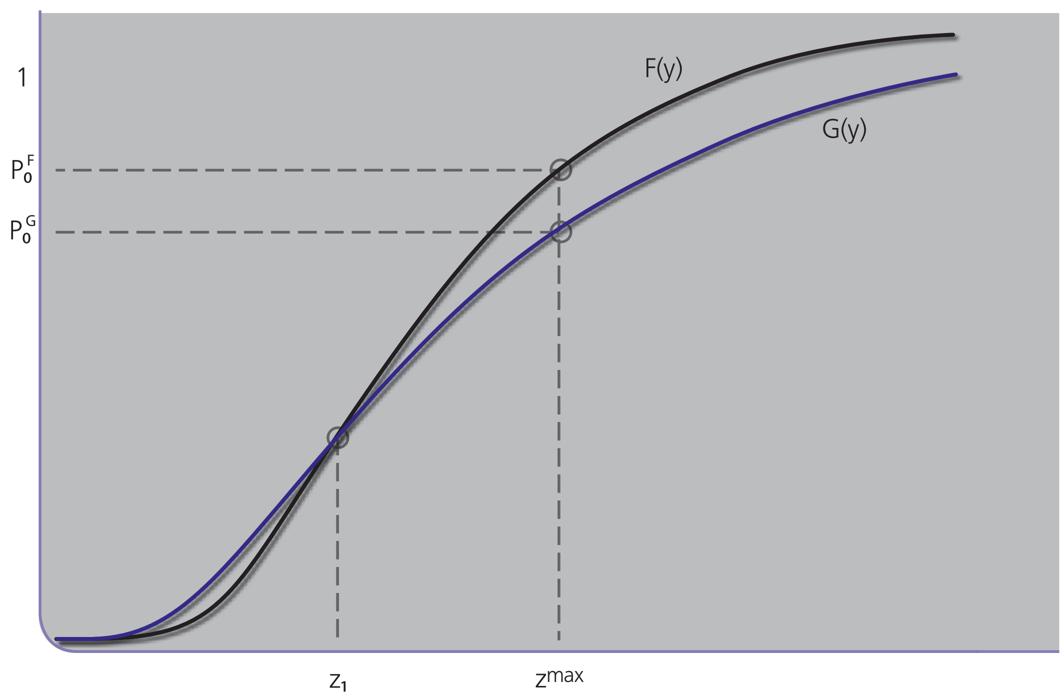


FIGURE 3.4 **The Poverty Deficit Curve**

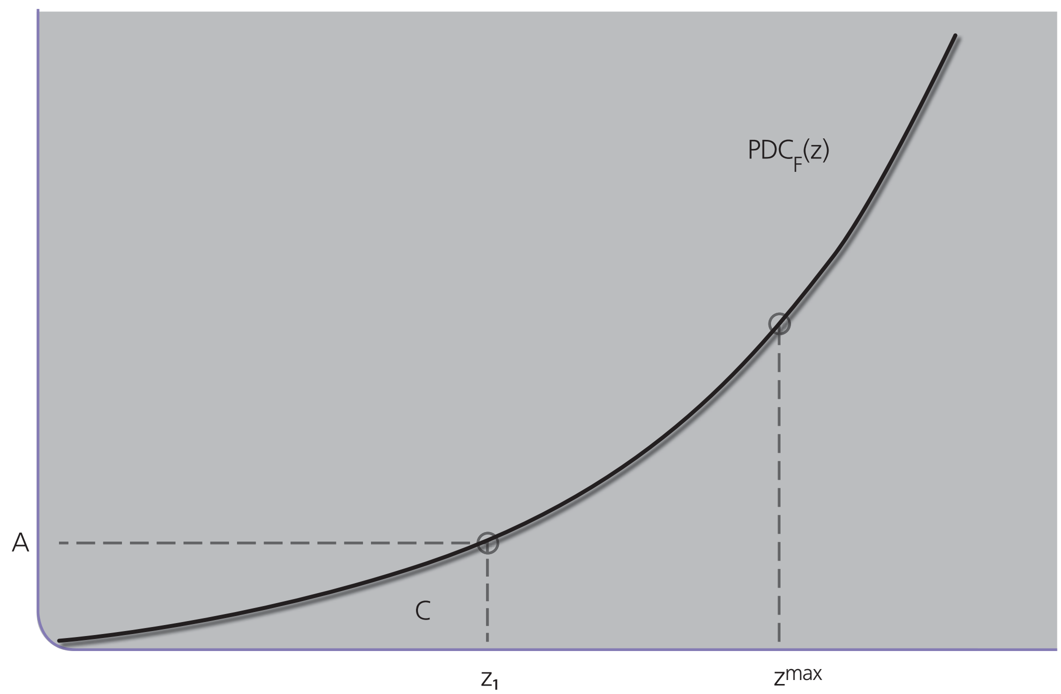
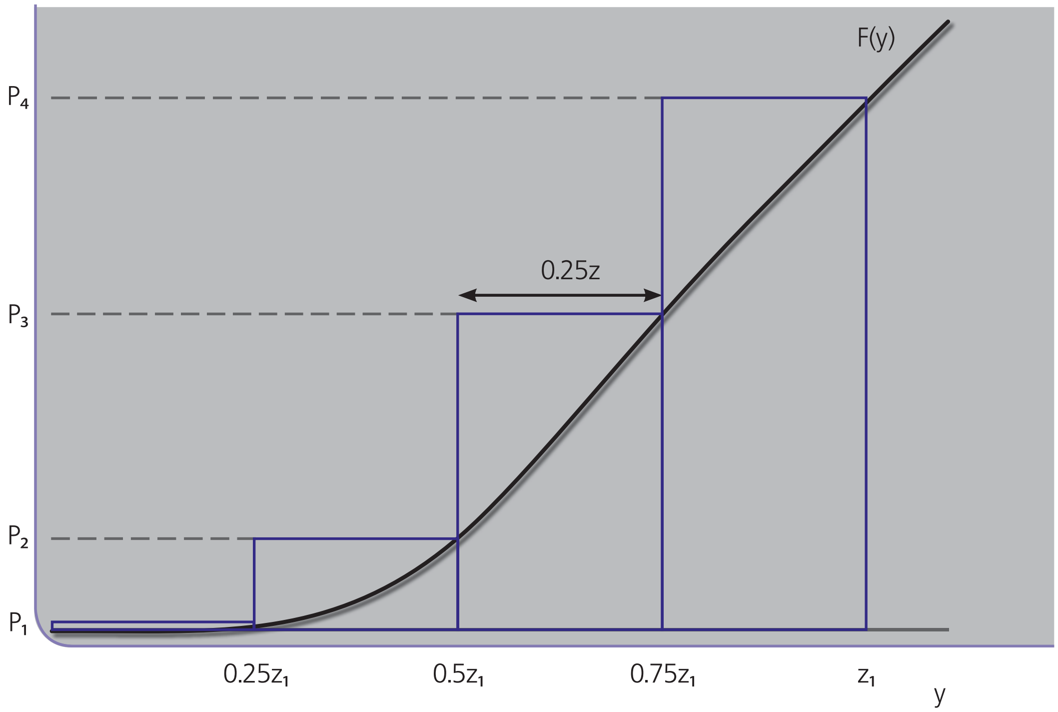


Figure 3.4 plots the areas beneath the initial CDF, $F(y)$. Given the poverty line z_1, the area beneath $F(y)$ up to this point is labelled A in Figure 3.1 and plotted in Figure 3.4 as the vertical distance *A*. As the poverty line rises, the area beneath the CDF obviously rises as the line labelled $PDC_F(z)$ illustrates.

What does the area beneath the CDF measure? It will be helpful to represent the continuous function $F(y)$ by its discrete analogue. We do this in Figure 3.5 for the area beneath z_1.[49] Imagine an economy in which m_1 individuals receive an income of $\frac{1}{4}z_1$; m_2 individuals receive an income of $\frac{1}{2}z_1$; m_3 individuals receive an income of $\frac{3}{4}z_1$ and m_4 individuals receive an income of exactly z_1 but are counted as being poor.

[49] Figure 3.5 'zooms' in on the CDF region of interest.

FIGURE 3.5 A Discrete CDF



The CDF for such a distribution is shown in Figure 3.5: a proportion p_1 of the population receive an income of $\frac{1}{4}z_1$ (or less); a proportion p_2 receive an income equal to or less than $\frac{1}{2}z_1$; a proportion p_3 receive an income equal to or less than $\frac{3}{4}z_1$; and finally a proportion p_4 receive an income equal to or less than z_1 itself. Notice that the width of each histogram is 0.25z and the height given by the relevant p. The PDC can be approximated by the sum of areas of the four histograms, which can be written as

$$PDC(z_1) \approx p_1 \frac{z_1}{4} + p_2 \frac{z_1}{4} + p_3 \frac{z_1}{4} + p_4 \frac{z_1}{4}$$

This turns out to be the simple income gap measure, defined above as

$$\tilde{P}_1 = \frac{1}{n} \sum_{i=1}^{m} \left(z - y_i\right)$$

Given the numbers in each income class, the simple income gap measure is

$$\tilde{P}_1 = \frac{m_1}{n}\left(z_1 - \frac{1}{4}z_1\right) + \frac{m_2}{n}\left(z_1 - \frac{1}{2}z_1\right) + \frac{m_3}{n}\left(z_1 - \frac{3}{4}z_1\right) + \frac{m_4}{n}(z_1 - z_1)$$

or

$$\tilde{P}_1 = \frac{m_1}{n}\left(\frac{3}{4}z_1\right) + \frac{m_2}{n}\left(\frac{1}{2}z_1\right) + \frac{m_3}{n}\left(\frac{1}{4}z_1\right) + \frac{m_4}{n}(0 \cdot z_1) \qquad [3.5]$$

The *m*'s and the *p*'s are related by

$$P_1 = \frac{m_1}{n}$$

$$P_2 = \frac{m_1}{n} + \frac{m_2}{n} = P_1 + \frac{m_2}{n}$$

$$P_3 = \frac{m_1}{n} + \frac{m_2}{n} + \frac{m_3}{n} = P_2 + \frac{m_3}{n}$$

$$P_4 = \frac{m_1}{n} + \frac{m_2}{n} + \frac{m_3}{n} + \frac{m_4}{n} = P_3 + \frac{m_4}{n}$$

$$P_5 = \frac{m_1}{n} + \frac{m_2}{n} + \frac{m_3}{n} + \frac{m_4}{n} + \frac{m_5}{n} = P_4 + \frac{m_5}{n}$$

which we rewrite as

$$\frac{m_1}{n} = P_1$$

$$\frac{m_2}{n} = P_2 - P_1$$

$$\frac{m_3}{n} = P_3 - P_2$$

$$\frac{m_4}{n} = P_4 - P_3$$

$$\frac{m_5}{n} = P_5 - P_4$$

Substituting these terms in equation [3.5] gives

$$\tilde{P}_1 = P_1 \left(\frac{3}{4} z_1 \right) + (P_2 - P_1) \left(\frac{1}{2} z_1 \right) + (P_3 - P_2) \left(\frac{1}{4} z_1 \right) + (P_4 - P_3)(0 \cdot z_1)$$

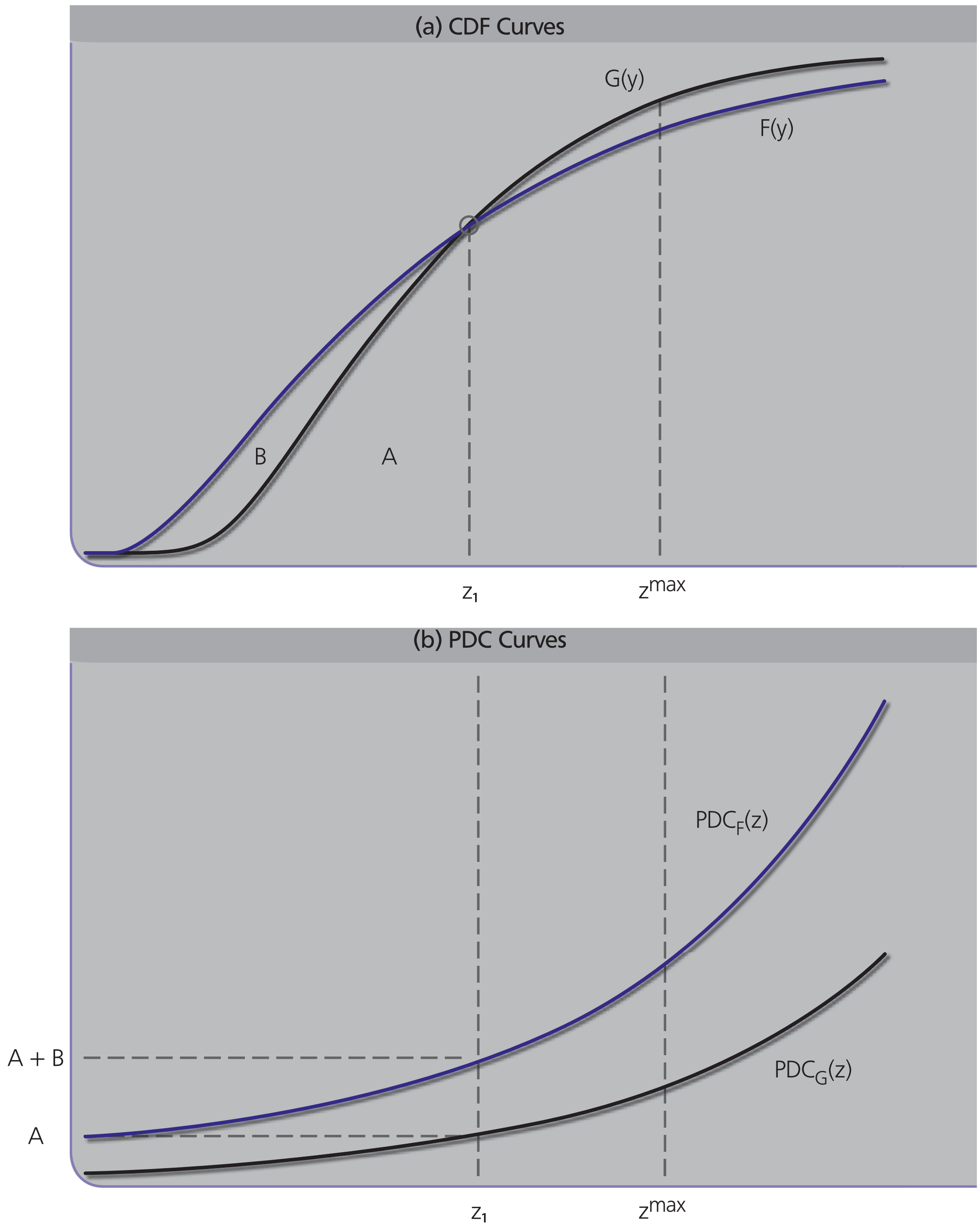
and this simplifies to

$$\tilde{P}_1 = p_1 \frac{z_1}{4} + p_2 \frac{z_1}{4} + p_3 \frac{z_1}{4} \qquad\qquad PDC(z_1) \approx p_1 \frac{z_1}{4} + p_2 \frac{z_1}{4} + p_3 \frac{z_1}{4} + p_4 \frac{z_1}{4}$$

which is very similar to the PDC. The difference between them arises only because we are taking a discrete analogue of the CDF. Imagine that instead of taking just four equal segments of the poverty line, we had taken (say) a hundred, then the two measures would be virtually identical. Indeed, in the continuous case, the area beneath the CDF curve is precisely the measure $\tilde{P}_1$.

Figure 3.6 panel (a) presents two intersecting CDF curves: $F(y)$ and $G(y)$. The case shown is the reverse of the Indonesian example. Here the proportion of the population receiving very low incomes is lower in the more recent period (where the CDF is $G(y)$) but higher at poverty lines closer to z^{max}. In this case, the headcount ratio would improve (worsen) at all z values

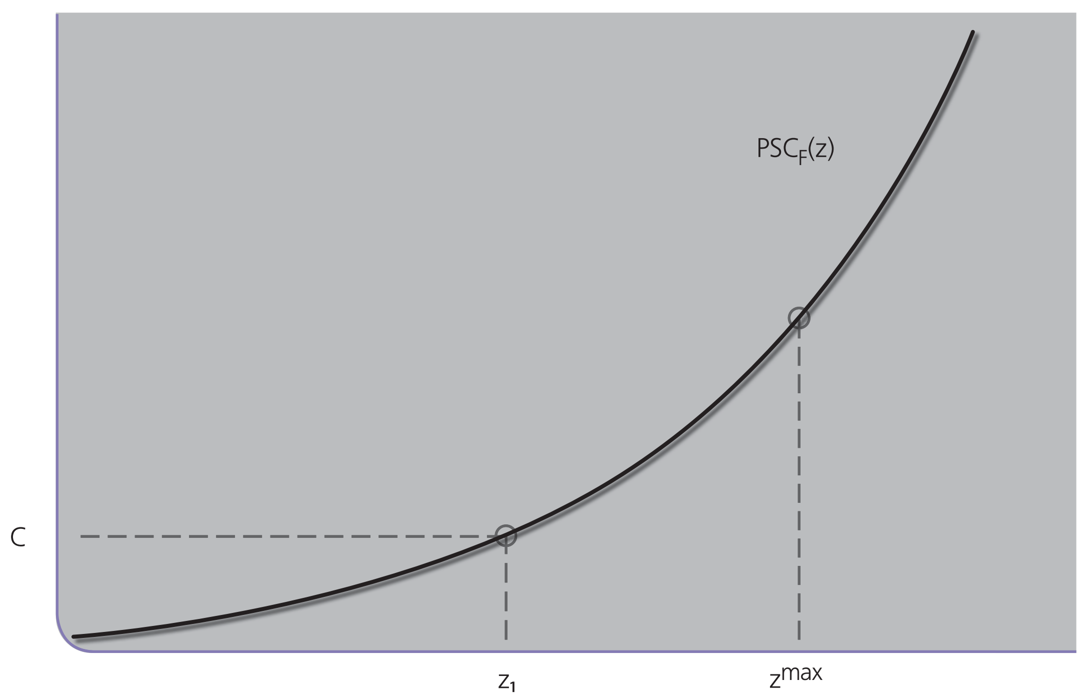
FIGURE 3.6 Second-Order Dominance



below (above) z_1. The corresponding PDC curves (with parallel subscripts *F* and *G*) are drawn in the panel (b). Where the curves intersect, the area beneath *G*(*y*) is A and that beneath *F*(*y*) is A+B. The area beneath *G*(*y*) is smaller than that beneath *F*(*y*) at all permissible poverty lines up to z^{max}. In this case, the distribution *G*(*y*) 'second-order dominates' the distribution *F*(*y*) over the relevant income range. In terms of the FGT class of poverty measures, we would find that P_1 would be lower in the more recent period (when income is distributed according to *G*(*y*)) at every possible poverty line.

Of course, the PDCs may also intersect, implying that the P_1 measure may indicate an improvement over some values of *z* but deterioration over others. We can then compare areas beneath the PDCs. The area beneath the PDC has been called the 'poverty severity curve' (PSC). For example, plotting the area beneath the PDC curve in Figure 3.4 leads to the PSC curve shown in Figure 3.7. Note that at poverty line z_1, the area beneath the PDC curve is labelled *C*, and this is the vertical distance of the PSC curve at z_1. We can plot the PSC curves for the intersecting PDC curves. If the area beneath the more recent PDC curve is everywhere below the other, then *G*(*y*) 'third-order dominates' *F*(*y*). In fact, this would indicate that the P_2 measure of poverty (one that gives more weight to the poorest individuals) will be lower in the recent distribution for all values of *z* below z^{max}. Plotting CDFs, PDCs, and PSCs provides useful information, especially in cases where there is some doubt about the precise location of the poverty line. Such uncertainty may arise when poverty lines are being revised

FIGURE 3.7 **The Poverty Severity Curve**



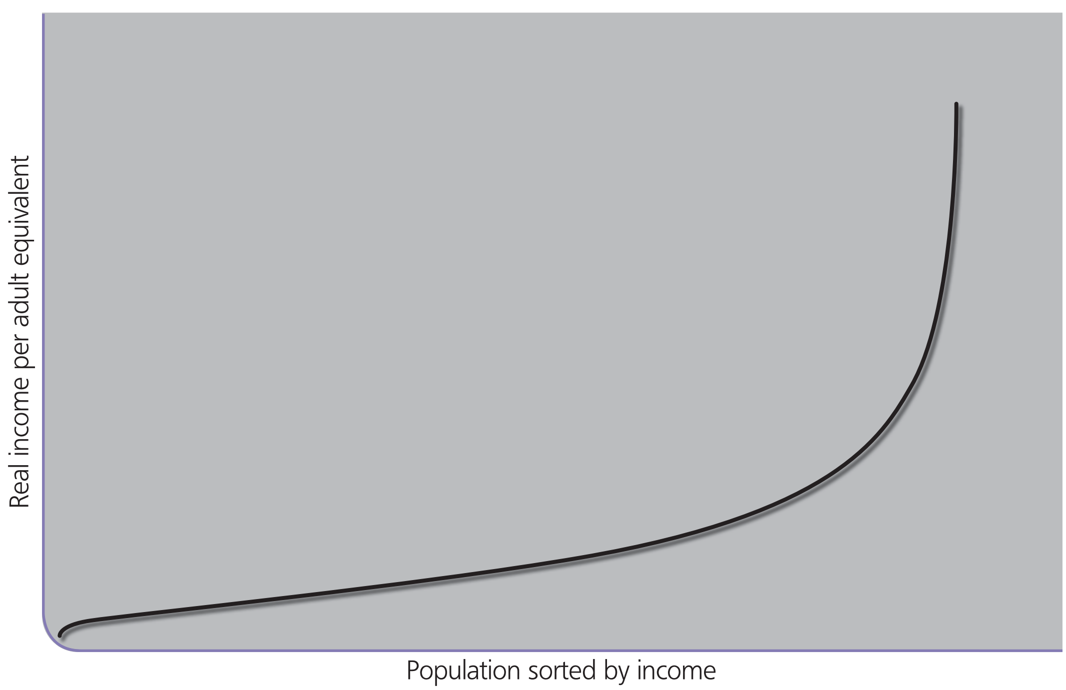
to reflect changing prices and where available consumer price data for typical low-income goods is unavailable.

Pen's Parade

In 1971, Jan Pen, a Dutch economist, suggested a novel way of graphing income distribution. The graph he proposed is very similar to the CDF, but with the axes switched. Imagine that every person in the economy walks by, as if in a parade—a parade that takes exactly an hour to pass. The marchers are arranged in order of income, with the lowest incomes at the front and the highest at the back. Also imagine that the heights of the people in the parade are proportional to what they earn: those earning the average income will be of average height, those earning twice the average income will be twice the average height, and so on.

What does the silhouette of the parade look like for a typical income distribution? He argued it would show a steady increase in height as we move from the poorest to the richest. Further, he held that we would see a parade of dwarves, with some oversized giants at the end. Imagine that you, the observer, are of average height, so those at the start of the one-hour parade are substantially shorter. Using UK income data, Pen argued that it would take 45 minutes before the marchers would be the same height as you, the observer. The parade for Malaysia in 2004 is shown in Figure 3.8 where the 'height' of each observation is proportional to household gross income per adult equivalent.

FIGURE 3.8 **Pen's Parade: Malaysia, 2004**



Pen's Parade illustrates the fact that income distributions tend to show more variation at their bottom and top ends: the very small dwarves at the start and the impressive giants at the end. Not a lot happens in the middle. The graph can be used to analyse changes in income below the poverty line. If the incomes of the poor are all rising, we would expect Pen's Parade in later years to be everywhere above those for earlier years. We illustrate this use when applying this method to Malaysian data in Chapter 4.

TIP Diagrams

Another particularly helpful graphical device has been proposed by Jenkins and Lambert (1997). The diagram neatly captures the incidence, intensity, and inequality of poverty, and they use the acronym TIP because the diagram illustrates these 'three I's of poverty'.

First Jenkins and Lambert define the poverty gap for individual i as

$$g(y_i, z) = \max(z - y_i, 0)$$

and the normalized poverty gap as

$$\Gamma(y_i, z) = \frac{g(y_i, z)}{z} = \max\left(\frac{z - y_i}{z}, 0\right)$$

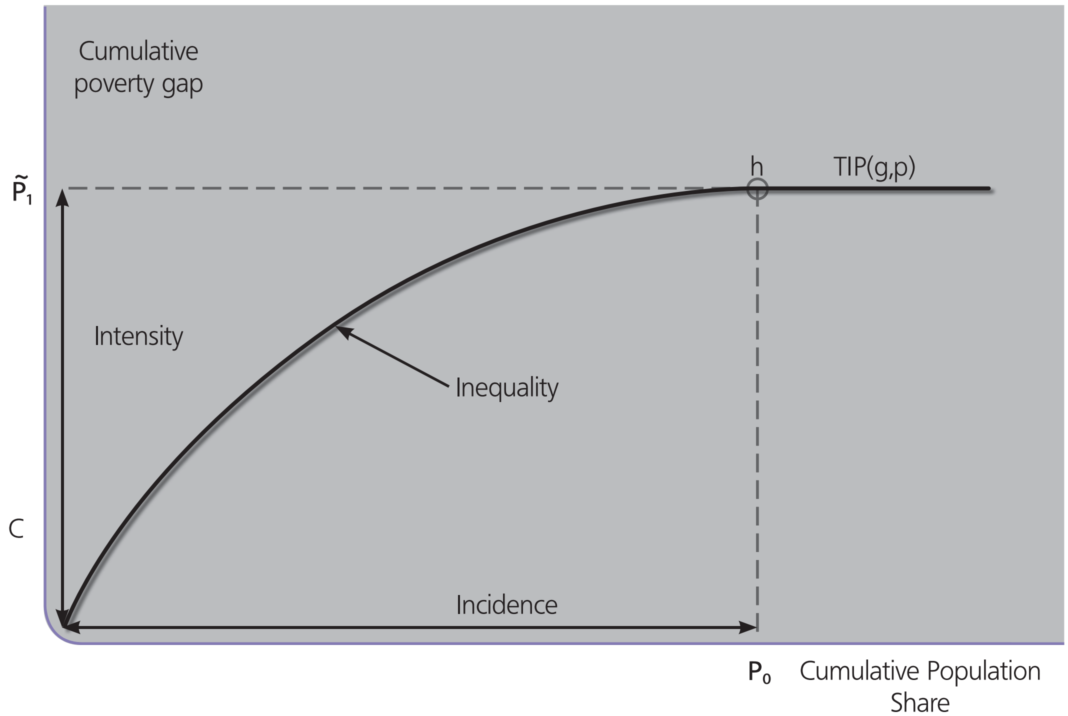
The TIP diagram is formed by first ranking individuals from the poorest to the richest, cumulating their poverty gaps (or normalized gaps), and plotting the cumulative per capita values against the cumulative share in the population. Figure 3.9 is an illustrative TIP diagram.

The poverty gap TIP curve is denoted $TIP(g,p)$ where p is the cumulative population share and that for normalized gaps is denoted $TIP(\Gamma,p)$. As we accumulate the gaps of increasingly richer individuals, we would expect the TIP curve to flatten, as each additional individual enjoys an income closer to z and hence the increment to the cumulative poverty gap reduces. The slope of the TIP curve at any p is therefore the income gap of that percentile. When we reach individuals whose income is equal to or greater than z, the income gap becomes zero and the TIP curve becomes horizontal—poverty gaps have a minimum of zero by assumption.

The start of the horizontal section (point h in the figure) identifies the incidence of poverty (i.e. the headcount P_0) on the horizontal axis and the per capita intensity of poverty on the vertical axis. This latter point corresponds to the $\tilde{P}_1$ measure (or P_1 when the poverty gap is normalized). The TIP curve illustrates the intensity of poverty on the vertical axis and its incidence on the horizontal.

This covers two of the 'I's'. How is the inequality of incomes amongst the poor illustrated? Imagine that every poor person had the same income so that his or her ranking would be irrelevant. The per capita cumulative poverty gap would rise by the same distance for each additional percentile added to the horizontal axis, so the TIP curve would be linear. The more unequal the distribution of income *amongst* the poor, the steeper will the TIP curve be at its start, when the very poorest persons (with large poverty gaps) are being included and the flatter will it be as the horizontal section is approached. So the third 'I'—inequality—is indicated by the curvature (concavity) of the TIP curve.

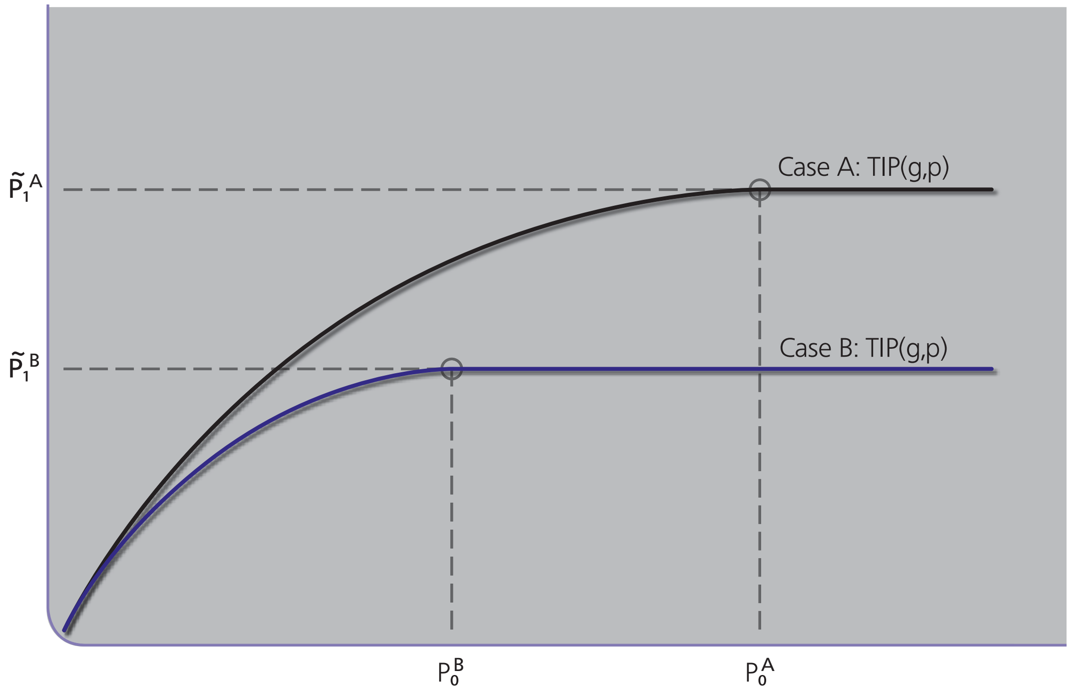
FIGURE 3.9 **The Three I's of Poverty (TIP) Curve**



Imagine a TIP curve for a population in which every person had zero income. This is the case of *maximum poverty*. For a poverty line of *z*, every poverty gap is *z* and the TIP curve will be a straight line (with slope *z*) from the origin to a point in the diagram with 1 on the horizontal axis and *z* on the vertical (recall that the vertical axis measures the *per capita* poverty gaps). At the other extreme, with *no* poverty, the TIP curve is simply the horizontal axis.

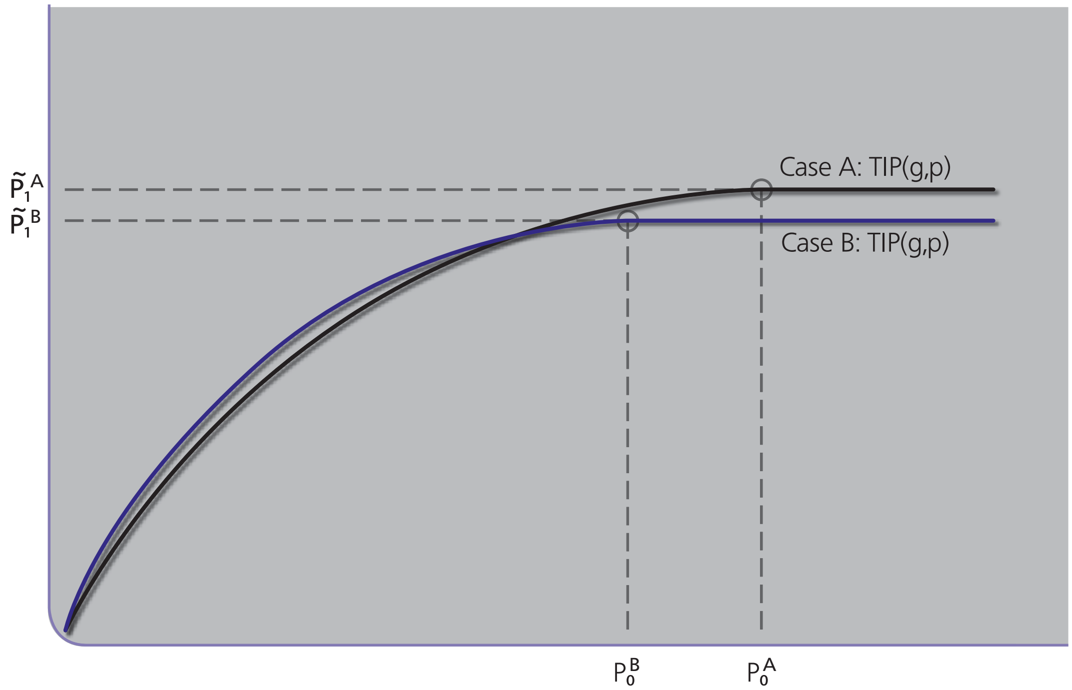
The usefulness of this graphical technique is best illustrated when we compare TIP curves from two different distributions—say for two different time periods. In Figure 3.10 we show TIP curves for the case where one TIP curve (labelled A) lies wholly above the other (labelled B). In the terminology of Jenkins and Lambert, distribution A 'TIP dominates' B. Intuitively, this means that the incidence, intensity, and inequality of poverty are all worse in case A compared with B. In fact, as Jenkins and Lambert (1996) showed, if case A TIP-dominates case B, then there is unanimous ordering for all FGT P_a measures with $\alpha \geq 1$ for all poverty lines of *z* and below. If the curves coincide or intersect, there is no TIP dominance.

FIGURE 3.10 **TIP Dominance**



The Indonesian example we have used in the section is illustrated in Figure 3.11. The distribution before the rise in the price of rice is given as Case A and that following the rise as Case B. Because the poorest individuals (net rice consumers) are made worse off, their income gaps increase, so the cumulative income gap (per capita) rises more steeply along the early part of Case B compared to the TIP curve for Case A. Because the richer poor (net rice producers) left poverty after the price rise, the headcount rate falls. In one convenient diagram the various dimensions of poverty are neatly captured: incidence is the distance along the horizontal axis, intensity is the distance along the vertical axis, and inequality of incomes amongst the poor is visually apparent through the curvature of the TIP curve.

FIGURE 3.11 **Intersecting TIP Curves**



4 MONITORING POVERTY: MALAYSIA, 1995–2004

MONITORING POVERTY: MALAYSIA, 1995–2004

Using the revised 2005 PLI for Malaysia (described in Chapter 2), this chapter analyses poverty trends in Malaysia by applying the indices of poverty reviewed in the previous chapter. The Malaysian economy continued its remarkable growth record in the decade following 1995—growth only stalling in the period immediately following the 1997 Asian crisis. Our analysis of poverty (and income distribution in Chapter 5) over this period is thus of double interest: (a) it illustrates the role of economic growth as a major factor behind poverty reduction; and (b) it explores how short-term macroeconomic disturbances have impacted on Malaysian poverty and distribution.[50]

The Household Income Survey (HIS)

Our analysis of poverty (in this chapter) and income distribution (in the next) is based on Malaysia's Household Income Survey (HIS). The HIS is currently carried out by the Department of Statistics (DOS) twice in every five years. The surveys contain detailed information on individuals and households, including household income (by source) and the socio-demographic characteristics of household members, such as their age, sex, education, health, and marital status. The HIS also contains useful labour force information such as employment status, usual occupation, and industry of each household member. The sample size is around 37,000 households (see Table 4.1). The HIS is both larger and more frequent than the Household Expenditure Survey (HES) and is the basis for official measures of poverty incidence in Malaysia.

The HIS covers persons living in private residences in Malaysia. This means that individuals living in an institutional setting, such as hotels, hospitals, and military barracks, will not be covered by the survey.[51] A household is defined as a person or group of persons who usually live together and make common provisions for food and 'other essentials of living'. The sampling frame for the 2004 HIS is based on Malaysia's 2000 Population and Housing Census. A two-stage stratified sampling design was adopted: the primary stratum consists of the states of Malaysia, including the Federal Territories of Kuala Lumpur and Labuan; the second consists of the urban–rural strata. An urban area consists of built-up areas with populations of 10,000 and above: other areas are defined as rural.[52]

In the HIS, household income is defined as the total income accruing to household members, both in cash and in kind 'on a regular basis in one year or more often'. An imputation is made for owner-occupation of dwellings. The *gross income* concept we adopt in the analysis of poverty includes income from paid work, self-employment, and asset income together with gross transfers.

[50] For a detailed review of Malaysia's remarkable economic growth performance and its effect on poverty and income inequality, see Leete (2007).
[51] In the context of poverty measurement, it is also important to note that the HIS does not, for obvious reasons, include the homeless.
[52] The term "rural" thus covers small urban communities with populations between 1,000 and 9,999.

The HIS covers both Malaysian citizens and foreign nationals (legal and illegal) but in this chapter and the next, we restrict the coverage to citizens only.

Household Incomes and PLIs

The indices of poverty reported in this section are based on Household Income Surveys for 1995, 1997, 1999, 2002, and the most recent 2004. A household is considered poor if its gross income is below its PLI, the latter reflecting the household's size, age–sex composition, and location (state/stratum). A striking feature of the period under review is the effect of the Asian financial crisis, which took its toll on incomes in 1999. Table 4.1 sets out the mean *nominal* gross incomes over the five surveys. Over all households in Malaysia, average household income *fell* by over 5 per cent in 1999 compared with 1997 (2.6 per cent per annum on average). Over the same period, mean income of poor households actually *increased* by over 10 per cent so the late 1990s recession, following the Asian crisis, seemed to harm the incomes of the non-poor most. However, as later observed, all indices of poverty rose in 1999.

TABLE 4.1 Mean Household Income: Malaysia, 1995–2004

Year	Number of Households	All Households		Poor Households	
		Gross Income	Average Growth p.a.	Gross Income	Average Growth p.a.
1995	37,356	2020	–	494	–
1997	36,546	2602	12.66	552	5.55
1999	36,503	2470	–2.60	615	5.40
2002	37,767	2999	6.47	652	2.92
2004	36,483	3249	4.00	753	7.20

The 2005 methodology allows the PLIs to reflect each household's demographic structure and location. The former determines the household's food requirement and allows the household to exploit economies of scale in housing expenditure. Location determines the prices households have to pay for food and non-food items. Table 4.2 presents for the HIS 2004 the mean PLI and household size by state and stratum, both for all households and for the poor. Variations in the PLI reflect the household size and composition: in particular, larger households have higher PLIs. They will also reflect the state/stratum food and non-food prices.

Over all states the average household size was 4.38 in urban areas and 4.77 in rural areas. If there were no urban–rural price differentials, we would expect the mean rural PLI to exceed its urban equivalent, reflecting the needs of larger households. In fact, the PLI for rural Malaysia (RM709 per month) is less than that of urban areas (RM723). This reflects the lower costs of living typical of most rural areas. The effect of household size on the mean PLI is most clearly appreciated by comparing the PLIs across states. In Sabah, for example, both urban and rural

PLIs are high—RM906 and RM913 respectively. These PLIs reflect the larger mean households in Sabah: 5.16 and 5.35 for urban and rural respectively. Also note that the poor households are the larger ones: the mean household sizes of poor households are 6.8 (urban) and 6.5 (rural), substantially higher than the overall average household size. Unsurprisingly the average PLI over poor households is significantly above that for all households.

TABLE 4.2 **Mean PLIs and Mean Household Size: Malaysia, 2004**

	Urban				Rural			
	All Households		Poor Households		All Households		Poor Households	
State	*Mean PLI**	*Mean HH Size*	*Mean PLI**	*Mean HH Size*	*Mean PLI**	*Mean HH Size*	*Mean PLI**	*Mean HH Size*
Johor	654	4.13	960	6.18	665	4.65	878	6.32
Kedah	668	4.43	954	6.49	668	4.74	877	6.24
Kelantan	674	4.95	889	6.70	671	5.37	916	7.50
Melaka	677	4.31	1036	6.75	650	4.52	944	6.50
N. Sembilan	621	4.07	906	6.50	645	4.23	1002	6.71
Pahang	624	3.95	1019	6.76	649	4.43	960	6.75
P. Pinang	677	4.01	763	4.33	713	4.59	1046	6.88
Perak	604	4.03	927	6.37	609	4.31	800	5.78
Perlis	633	4.32	769	5.33	585	4.20	716	5.14
Selangor	774	4.61	1088	6.86	701	4.73	948	6.56
Terengganu	716	4.86	1020	7.00	758	5.22	961	6.72
Sabah	906	5.16	1208	7.21	913	5.35	1084	6.48
Sarawak	799	4.62	1098	6.65	778	4.67	997	6.10
WP KL	760	3.87	1115	6.12				
WP Labuan	859	4.84	1039	5.78	927	5.36	1235	7.40
Malaysia	723	4.38	1075	6.80	709	4.77	980	6.46

Source: HIS 2004.
* Mean PLI in RM per month.

To define the PLIs for years earlier than 2004, we adopt the following procedure. We first calculate, for each household in the various HIS, its food and non-food PLI *in 2004 prices* and then apply a food and non-food CPI adjustment by region[53] and stratum. The CPI adjustment factors are set out in Table 4.3. Changes in the mean PLIs over time will reflect these price changes and changes in household demographics across survey dates (size of households and their age–sex composition).

[53] The three regions are Peninsular Malaysia, Sabah/Labuan, and Sarawak.

TABLE 4.3 Consumer Price Indices: Selected Years

Years	Peninsular Malaysia		Sabah/Labuan		Sarawak	
	Urban	Rural	Urban	Rural	Urban	Rural
Food						
1995	76.8	78.3	80.6	80.6	81.9	81.9
1997	85.5	85.7	83.5	83.5	84.8	90.3
1999	97.7	98.5	98.9	99.5	96.5	99.0
2002	102.1	101.0	100.2	99.0	99.3	100.8
2004	106.3	104.1	107.5	105.8	102.1	102.6
Non-Food						
1995	88.4	88.8	95.4	95.4	93.1	93.1
1997	93.2	92.3	95.5	97.4	95.6	94.3
1999	98.7	98.3	99.5	99.7	98.7	99.0
2002	104.4	104.5	103.2	102.4	102.4	102.6
2004	106.7	107.1	104.0	102.7	103.2	104.2

Source: DOS.
Note: 2000 = 100.

Indices of Poverty

The following indices of poverty were computed using HIS data for 1995, 1997, 1999, 2002, and 2004:

- Head-count rate: P_0. This measures poverty incidence.
- Normalized income gap: P_1. This measures poverty intensity.
- Normalized income gap squared: P_2. This measures poverty severity.
- Watts index: *W*. This is another measure of poverty intensity.
- Time Out of Poverty: t^p: This is the average time required for the poor to 'escape' from poverty.

Defining z to be the household PLI, y to be household income, m the number of poor households, and n the total number of households, the poverty indices are defined as follows:

- $P_0 = \frac{1}{n}\sum_{i=1}^{m}\left(\frac{z_i - y_i}{z_i}\right)^0 = \frac{m}{n},$ the incidence of poverty
- $P_1 = \frac{1}{n}\sum_{i}^{m}\left(\frac{z_i - y_i}{z_i}\right)$ the intensity of poverty
- $P_2 = \frac{1}{n}\sum_{i}^{m}\left(\frac{z_i - y_i}{z_i}\right)^2$ the severity of poverty
- $W = \frac{1}{n}\sum_{i}^{m}\left[\ln(z_i) - \ln(y_i)\right]$ the Watts Index
- $t^P(\gamma) = \frac{W}{\gamma \cdot P_0}$ average time out of poverty

Poverty Incidence

The Foster-Greer-Thorbecke (FGT) measures are set out in Table 4.4. The two key features of all these indices is their overall decline for Malaysia between 1995 and 2004, interrupted by the effects of the late Asian financial crisis which affected incomes in 1999.[54] The 'headline' poverty rates[55] (or P_0) were 9.86 per cent, 6.67 per cent, 8.14 per cent, 6.19 per cent, and 5.96 per cent in the years 1995, 1997, 1999, 2002, and 2004. The incidence of poverty increased significantly in 1999 but has otherwise shown a steady decline over the ten-year period.

It is also clear that poverty is largely a rural phenomenon: in 2004 the urban poverty rate was 2.7 per cent compared with a rural rate of 12.3 per cent. This is reflected in the ethnic and state patterns of incidence. Poverty amongst the Bumiputera (who dominate rural populations) is highest at 8.6 per cent in 2004, and poverty rates amongst the most rural states is also high: Kedah, Kelantan, Terengganu, Sarawak and Sabah/Labuan. Poverty incidence in the latter is the highest. Of the poorest states, Kedah and Sarawak have made considerable progress in poverty reduction in 2004. Poverty amongst the Chinese (predominantly urban) community has been virtually eradicated. As we observed in Chapter 1, these poverty rates are a little above those implied by the higher of the two World Bank international PLIs.[56]

Poverty incidence has actually risen in recent years in some relatively prosperous states. For example, in Kuala Lumpur the poverty rate was 0.58 per cent in 1997 and in subsequent years, it increased to 1.6 per cent in 2004.

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[54] The mid-1980s recession had a similar short-run effect on mean incomes and poverty. For an analysis of the effects of the 1985 recession on poverty in Malaysia, see Demery and Demery (1991, 1992).
[55] The measures of poverty shown in Table 4.4 refer to households, rather than individuals. We examine individual and child poverty rates later in this chapter.
[56] See Table 2.2 above.

TABLE 4.4 Indices of Poverty: Malaysia, 1995–2004 *(per cent)*

	P_0					P_1					P_2				
	1995	*1997*	*1999*	*2002*	*2004*	*1995*	*1997*	*1999*	*2002*	*2004*	*1995*	*1997*	*1999*	*2002*	*2004*
Malaysia	9.86	6.67	8.14	6.19	5.96	2.69	1.64	2.09	1.53	1.45	1.09	0.61	0.82	0.57	0.54
Urban	3.81	2.17	2.96	2.48	2.72	0.94	0.49	0.68	0.56	0.60	0.36	0.17	0.26	0.20	0.21
Rural	7.24	11.80	14.02	13.64	12.28	4.84	2.96	3.69	3.47	3.11	1.98	1.12	1.45	1.29	1.18
Ethnic Group															
Bumiputera	14.05	9.82	11.63	9.15	8.59	3.93	2.48	3.03	2.29	2.13	1.61	0.93	1.20	0.86	0.80
Chinese	1.54	0.63	1.26	1.11	0.76	0.29	0.11	0.24	0.23	0.12	0.10	0.04	0.08	0.07	0.03
Indians	4.06	2.35	3.12	2.87	3.21	0.94	0.28	0.58	0.63	0.69	0.32	0.06	0.17	0.20	0.23
Others	8.11	19.47	27.67	9.97	6.87	7.73	4.85	7.65	2.76	1.73	3.04	1.65	3.09	1.16	0.67
State															
Johor	2.77	1.49	2.77	2.34	2.13	0.60	0.30	0.58	0.48	0.37	0.21	0.11	0.19	0.14	0.12
Kedah	12.13	11.02	13.70	10.22	6.85	2.97	2.78	3.61	2.69	1.58	1.11	1.06	1.43	1.10	0.53
Kelantan	22.92	19.70	17.64	14.30	10.45	6.38	5.02	4.53	3.49	1.88	2.57	1.87	1.80	1.27	0.51
Melaka	4.71	1.38	2.83	1.71	1.98	0.98	0.25	1.24	0.31	0.31	0.31	0.06	0.96	0.08	0.08
N. Sembilan	4.96	2.62	3.96	2.57	1.62	0.96	0.45	0.80	0.49	0.28	0.31	0.12	0.25	0.14	0.09
Pahang	9.38	6.24	7.86	8.78	4.13	2.42	1.23	1.54	1.86	0.91	0.94	0.40	0.47	0.60	0.30
P. Pinang	2.89	1.57	1.27	1.36	0.31	0.56	0.27	0.18	0.27	0.04	0.18	0.12	0.06	0.09	0.01
Perak	9.02	3.73	6.35	6.05	5.20	2.13	0.64	1.50	1.45	1.19	0.76	0.18	0.55	0.55	0.42
Perlis	11.34	7.74	13.31	8.65	6.60	2.56	1.90	2.80	2.13	1.52	0.83	0.72	0.93	0.77	0.58
Selangor	2.51	1.33	1.93	1.72	1.19	0.66	0.27	0.38	0.43	0.20	0.26	0.09	0.12	0.18	0.05
Terengganu	34.14	21.26	21.41	13.59	15.54	11.38	6.28	5.44	3.35	3.87	5.14	2.59	2.05	1.18	1.43
Sabah/Labuan	26.74	20.68	26.80	18.99	24.30	8.49	5.88	8.16	5.64	7.30	3.81	2.35	3.46	2.28	3.10
Sarawak	13.74	10.21	10.82	12.20	8.02	3.37	2.31	2.72	2.84	1.61	1.23	0.79	1.00	0.95	0.49
WP KL	1.23	0.58	0.59	1.05	1.60	0.30	0.07	0.12	0.17	0.33	0.10	0.01	0.04	0.04	0.12
Region															
Pen. Malaysia	8.01	5.20	6.30	4.80	3.73	2.13	1.24	1.52	1.14	0.79	0.84	0.46	0.58	0.42	0.26
Sabah/Labuan	26.74	20.68	26.79	18.99	24.26	8.49	5.88	8.00	5.64	7.35	3.81	2.35	3.38	2.28	3.12
Sarawak	13.74	10.21	10.82	12.20	8.02	3.37	2.31	2.72	2.84	1.61	1.23	0.79	1.00	0.95	0.49

Poverty Intensity and Severity

Measures of poverty 'intensity' (P_1) and 'severity' (P_2) followed the same pattern as incidence, showing an improvement over the whole period but with a worsening in the recessionary year, 1999. The three FGT measures tell the same story: the incidence, intensity, and severity of poverty all declined in Malaysia over the last decade, save for the exceptional year 1999. We shall later confirm this using graphical method.

The figures reported in Table 4.4 are subject to sampling error but with sample sizes of the sort provided by the HIS, the confidence intervals are quite small, that is, the FGT measures are precisely estimated. This is illustrated with state figures for 2004 in Table 4.5, where it is shown that we can be 95 per cent confident that the true population values lies within the confidence intervals shown.

TABLE 4.5 Confidence Intervals for Incidence (P_0) and Depth of Poverty (P_1)*

State	P_0	95% Confidence		P_1	95% Confidence	
Johor	2.13	1.69	2.57	0.37	0.27	0.48
Kedah	6.85	5.90	7.81	1.58	1.31	1.85
Kelantan	10.45	9.30	11.60	1.88	1.62	2.14
Melaka	1.98	1.08	2.88	0.31	0.13	0.48
N. Sembilan	1.62	0.90	2.35	0.28	0.11	0.45
Pahang	4.13	3.08	5.18	0.91	0.63	1.20
P. Pinang	0.31	0.09	0.54	0.04	0.01	0.08
Perak	5.20	4.46	5.95	1.19	0.98	1.40
Perlis	6.60	4.99	8.22	1.52	1.04	1.99
Selangor	1.19	0.84	1.54	0.20	0.13	0.27
Terengganu	15.54	13.98	17.09	3.87	3.38	4.35
Sabah	25.49	24.05	26.93	7.74	7.20	8.28
Sarawak	8.02	6.97	9.06	1.61	1.35	1.88
WP KL	1.60	1.12	2.09	0.33	0.20	0.46
WP Labuan	3.37	1.30	5.43	0.62	0.09	1.14
Malaysia	5.96	5.72	6.21	1.45	1.38	1.52

* Percentages by state, 2004.

Chapter 3 noted that the FGT poverty indices are all decomposable. To appreciate the practical usefulness of this, consider the urban, rural, and overall P_1 measures. The (weighted) proportion of households living in urban areas in 2004 was 0.66 (0.34 were rural). The urban and rural P_1 estimates given in Table 4.4 are 0.601 per cent and 3.110 per cent respectively. The Malaysian P_1 can thus be derived as a weighted average of these two values:

$$P_1 = 0.66 \text{ x } 0.601 + 0.34 \text{ x } 3.110 = 1.452$$

which is the value for all Malaysia reported in Table 4.5. Similarly, the value of 1.452 for P_1 is a weighted average of the state values for P_1, where the weights are the proportions of households in each state. We shall later see (in Chapter 5) that this property of decomposability is particularly useful when analysing income distribution.

Time Out of Poverty

An intuitive way to appreciate the changing depth of poverty is to use the Watts index to derive the time it will take the average poor person to escape from poverty under different assumptions of income growth (defined in Chapter 3 as $t^P(\gamma)$, where γ is the assumed growth rate). Table 4.6 presents the average time out of poverty for Malaysia and for the states with the lowest (Penang) and highest (Sabah) poverty rates.

TABLE 4.6 The Average Time Out of Poverty $t^P(\gamma)$: Malaysia, Penang, and Sabah

	Watts Index	Time Out of Poverty (Years)	
Area and Year	*%*	*$\gamma = 5\%$*	*$\gamma = 7.5\%$*
Malaysia			
1995	3.547	7.20	4.80
1997	2.100	6.30	4.20
1999	2.674	6.57	4.38
2002	1.960	6.33	4.22
2004	1.864	6.25	4.17
Penang			
1995	0.687	4.76	3.18
1997	0.287	3.66	2.44
1999	0.255	4.02	2.68
2002	0.335	4.92	3.28
2004	0.048	3.05	2.03
Sabah			
1995	11.727	8.77	5.85
1997	7.698	7.44	4.96
1999	10.942	8.01	5.34
2002	7.594	7.80	5.20
2004	10.385	8.15	5.43

The reduced depth of poverty is reflected in the declining time it will take for the average poor household to leave poverty. In 1995, if all incomes grew at 5 per cent per annum, it would take on the average poor household 7.2 years to escape poverty.[57] By 2004, this figure had steadily declined to 6.25 years, rising only in the recession year 1999. For the poor in the relatively rich state of Penang, the numbers are lower: in 1995 the average time out of poverty was only 4.76 years, falling to just over 3 years in 2004. By contrast, the average poor in Sabah in 2004 will escape poverty in over 8 years with 5 per cent growth and in 5.43 years even if incomes were growing at 7.5 per cent per year. These results confirm those of the FGT indices but in a way that is perhaps more intuitively appreciated.

Individual and Child Poverty

The poor households in Malaysia are typically larger in size than the non-poor, a feature that is increasingly the case (Leete 2007). In 1995 the average size of poor and non-poor households was 5.96 and 4.50 respectively. In 2004 the respective figures were 6.56 and 4.38. To appreciate the implication of this, we calculate the proportion of poor *individuals* (rather than households). Since poor households are larger, the individual incidence of poverty will be greater than the fraction of poor households. The individual poverty rate is defined as the proportion of individuals living in households with an income below the household poverty line. The relevant rates are set out in Table 4.7.

Because poorer households tend to be larger, the proportion of poor individuals is greater than the proportion of households in every year. In the recession year 1999, over 10 per cent of Malaysians lived in households with an income below the PLI, a number that fell just below 9 per cent in 2004.

Since large households are often large because of the presence of children, it is also revealing to examine the child poverty rate, defined as the proportion of children aged less than 16 years old in the HES sample who live in poor households. The rates, given in Table 4.7, are substantially higher than those for individuals and households. Moreover, the proportion of poor children in poverty was actually higher in 2004 (12.63 per cent) than it was seven years earlier (12.46 per cent). Child poverty rates are particularly important for Malaysia's future. Children are tomorrow's adults and if a substantial proportion of them have a disadvantaged start in life there will be longer-term consequences. The health and education status of future generations will be harmed by impoverished early years. The rates of individual and child poverty are particularly worrying for the poorer states. In Sabah, for example, 32 per cent of individuals and over 40 per cent of children were in poor households in 2004. The figures for the same year in Terengganu were 21 per cent of individuals and 26 per cent of children.

[57] Of course, this figure is an average. Households close to the PLI will escape from poverty in fewer years and for the very poor households, it would take longer than the average.

TABLE 4.7 **Household, Individual, and Child Poverty Rates: Malaysia, 1995–2004**

Year	Poverty Rates (%) Household	Individual	Child
1995	9.86	12.64	17.27
1997	6.67	8.83	12.46
1999	8.14	10.80	15.11
2002	6.19	8.40	12.05
2004	5.96	8.68	12.63
State	**Poverty Rates (%) by State, 2004** Household	Individual	Child
Johor	2.13	3.11	4.68
Kedah	6.85	9.36	12.32
Kelantan	10.45	14.59	18.52
Melaka	1.98	3.03	4.25
N. Sembilan	1.62	2.61	3.99
Pahang	4.13	6.64	9.63
P. Pinang	0.31	0.41	0.78
Perak	5.20	7.47	10.86
Perlis	6.60	8.10	9.90
Selangor	1.19	1.74	2.63
Terengganu	15.54	21.05	25.87
Sabah	25.49	32.51	41.61
Sarawak	8.02	10.63	14.91
WP KL	1.60	2.54	4.63
WP Labuan	3.37	4.05	2.98

Child and Individual Poverty Using Equivalence Scales

The identification of poverty with larger households depends of course on the way in which the 2005 PLI varies with household composition and size.[58] To check the robustness of the individual and child poverty rates reported in the previous section, we define for the year 2004 a single PLI per adult equivalent and define a household as poor with equivalized real income below it,[59] using the OECD adult equivalence scale. In this scale, the first adult is counted as one, each additional adult counts as 0.7, and children are weighted by 0.5. So a family of two adults and three children are equivalent to 1 + 0.7 + 3x0.5 = 3.2 'equivalent adults'. The PLI per adult equivalent is chosen to give the same household poverty rate as the 2005 PLI. A household is poor with an equivalized income of less than RM279.8 in 2004. Using this method, the 2004 individual poverty rate is estimated to be 8.5 per cent and the child poverty rate 12.1 per cent (the household rate being 5.96 per cent). These compare with rates of 8.7 per cent and 12.6 per cent using the 2005 PLI. These estimates are remarkably close, suggesting that our estimates of child poverty rates are robust to alternative ways of allowing for household size and composition.

Relative Poverty in Malaysia

Household poverty has been declining as indicated by the 2005 absolute PLI. It is also important to investigate whether low income earners are faring better or worse than the average household. To do this, we apply the concept of relative poverty to the Malaysian income data. We follow the European Union (EU) definition of relative poverty by defining a household as poor if its income per adult equivalent is below 60 per cent of the median income per adult equivalent. We also take a less generous relative PLI by adopting an equivalized threshold income of 50 per cent of the median. To allow for state–stratum variations in prices, we deflate each household's gross income by its relative price index[60], with the index set to unity for KL. The adjusted 'real' income for each household is that of an equivalent household living in KL. Real income is equivalized by dividing by the number of equivalent adults in the household. We use the simple OECD adult equivalent scale described above.

To avoid the undue influence of outliers, the median has been calculated from trimmed subsamples, ignoring the top percentile in each year. The resulting threshold levels of income (in KL prices) per adult equivalent are given in the final column of Table 4.8. The family described above (two adults and three children) would, by the EU 60 per cent standard, be defined as poor in 2004 if its income (in KL prices) were below RM1,802 per month (i.e. 3.2 x 563.19). By the 50 per cent standard, it would be defined as poor if its income were below RM1,502 per month (i.e. 3.2 x 469.33).

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[58] Food needs vary with sex and age of household members and there are economies of scale in housing expenditures.
[59] Nominal household incomes are deflated by an index of the state/stratum prices (KL = 1).
[60] The food and non-food weights are those components of the household's PLI, so the price index is defined at the household level.

TABLE 4.8 Relative Poverty: Malaysia, 1995–2004

	60% of Median Equivalized Real Income		
Year	P_0	P_1	*PLI*
1995	24.5	7.9	345.0
1997	25.2	8.3	451.6
1999	24.4	7.7	438.5
2002	25.7	8.3	524.7
2004	25.6	8.5	563.2
	50% of Median Equivalized Real Income		
Year	P_0	P_1	*PLI*
1995	17.6	5.3	287.5
1997	18.3	5.6	376.4
1999	17.2	5.1	365.4
2002	18.5	5.5	437.2
2004	18.7	5.8	469.3

The resulting poverty indices (P_0 and P_1) are set out in Table 4.8. Two features are clear. First the relative poverty rates are much higher than the absolute rates based on the 2005 methodology because the relative PLIs are substantially more generous. Secondly the relative poverty rate has been fairly stable over the past 10 years: around a quarter of households had an equivalized income below 60 per cent of the median and just below a fifth had incomes per adult equivalent less than half the median.

Households with normalized income (income per adult equivalent) below 60 per cent or 50 per cent of the median were larger than those above, so the association of poverty with household size applies equally to the relative income approach. For example in 2004, the mean size of poor household was 5.6 (PLI 60 per cent of median) and 5.8 (50 per cent of median) whereas the mean size of non-poor households was 4.1 (60 per cent of median) and 4.2 (50 per cent of median). Because of this, individual and child poverty rates are above those for households given in Table 4.8. For example in 2004, 31 per cent of children were in households with equivalized income less than half Malaysia's median, and in Sabah the figure was as high as 63 per cent.

Net versus Gross Income

The official poverty rates for Malaysia are based on the gross income definition of income. In this section, we analyse poverty using the *net income* definition. Poor households pay little or no income tax, so these deductions from gross income can be expected to make little difference. A number of households remit their earnings to other households (generally their immediate family and dependants). The net income definition takes account of such inter-household transfers. In Table 4.9 we present two FGT indices based on net income.

The poverty rates are a little higher using the net income definition: 11.76 per cent in 1995 compared with 9.86 per cent using gross income; and in 2004 the net income poverty rate was 7.25 per cent compared with 5.96 per cent for gross income. This suggests that some households fall below the PLI as a result of transfers to other households. The most striking feature is the fact that the net income poverty rate did not rise in 1999, unlike that using gross income. In fact both P_0 and P_1 went up in 1997 but fell in 1999. This suggests that intra-household transfers were used to assist households most acutely affected by the macroeconomic shocks in the late 1990s.

Poverty Profiles

One way to discover the factors lying behind poverty is to construct poverty profiles: we could calculate poverty rates by informative subgroups of households or calculate the fraction of poor households in the subgroups. A set of such profiles for 2004 is given in Table 4.10.

TABLE 4.9 Household Poverty Using Gross and Net Income: Malaysia, 1995–2004

	Gross Income		Net Income	
Year	P_0	P_1	P_0	P_1
1995	9.86	2.69	11.76	3.19
1997	6.67	1.64	15.58	6.07
1999	8.14	2.09	9.74	2.51
2002	6.19	1.53	7.77	1.92
2004	5.96	1.45	7.25	1.80

The second column reports the incidence of poverty amongst the subgroups listed in the first column. So of households whose head has no formal schooling, nearly 13 per cent were poor in 2004. As one would expect, the proportions of poor amongst households with more educated heads fall, only 0.3 per cent of households with heads educated beyond secondary level were poor. The third column in the table reports the proportions of poor households in each subgroup in the first column. Amongst poor households, over two thirds have either no formal education or only up to primary level.

From Table 4.10, it is apparent that the number of income recipients in the household is an important determinant of poverty. Amongst households with only one income recipient, nearly 9 per cent were poor and the incidence falls as income recipients rise. Over two thirds of poor households had only one income recipient.

The final profile in Table 4.10 reports the incidence of poverty by household size. Over 80 per cent of poor households had five or more members and only 5 per cent were single- or double-member households. The incidence of poverty amongst one- or two-member households was only 1.6 per cent compared with over 10 per cent for the larger households.

TABLE 4.10 Poverty Profiles: Malaysia, 2004

Variable	P_0 %	Share Amongst the Poor %
Schooling		
Primary 1	14.773	1.292
Primary 2 and 3	10.810	8.338
Primary 4 and 5	8.908	6.454
Primary 6	9.509	29.099
Form 1 and 2	7.331	4.191
Form 3/Junior Middle 3	6.081	15.640
Form 4	6.249	0.953
Form 5, Senior Middle 3	2.270	10.193
Lower Sixth Form	4.184	0.099
Upper Sixth Form	1.256	0.574
College (Maktab) and HEI	0.301	0.637
No Formal Education	12.956	22.531
None	12.956	22.531
Primary	9.731	45.182
Secondary	3.828	31.649
Tertiary	0.301	0.637
Number of Income Recipients		
1	8.898	67.939
2	4.071	23.567
3	2.892	6.229
4	1.974	1.573
5 or more	1.777	0.692
Size of Household		
One or two members	1.552	5.214
Three or four members	2.531	13.718
Five or more	10.151	81.068

Extreme Poverty

Historically Malaysia has monitored poverty using two PLIs: the standard 1977 PLI (as explained in Chapter 2) and a PLI designed to capture 'hard-core' or extreme poverty. Formerly, a household was considered to be in extreme poverty if its income fell below half the standard PLI. In the revised 2005 methodology, a household is considered extremely poor if its income is less than the *food component* of the PLI. Table 4.11 shows the extreme poverty rates (with the 'standard' rates also presented for ease of comparison).

TABLE 4.11 Extreme Poverty Rates: Malaysia, 1995–2004

	Extreme Poverty Rates (%)		
Year	*Household*	*Individual*	*Child*
1995	2.16	3.10	4.38
1997	1.32	2.00	3.02
1999	1.93	2.82	4.20
2002	1.34	2.02	2.98
2004	1.23	1.98	3.04
	'Standard' Poverty Rates (%)		
Year	*Household*	*Individual*	*Child*
1995	9.86	12.64	17.27
1997	6.67	8.83	12.46
1999	8.14	10.80	15.11
2002	6.19	8.40	12.05
2004	5.96	8.68	12.63

In 1995, 2.2 per cent of households received an income which was insufficient to meet their basic food requirements. By 2004 this had fallen to 1.2 per cent. The extreme poverty rate only rose in the exceptional year 1999. As with the standard poverty rate, the extremely poor households were the larger ones, so the individual (2 per cent) and child (3 per cent) poverty rates were higher than the household rates. The aim of the country's latest development plan, Ninth Malaysia Plan (9MP), is to completely eliminate hard-core or extreme poverty. This is a challenging task, as illustrated by the relatively small reduction in the extreme poverty rate over the two years after 2002.

Multivariate Analysis

The profiles in Table 4.10 have one major weakness: we are restricted to two dimensions, for example, the incidence of poverty by household size. The dimensionality of the tables can be extended by, for example, presenting the incidence of poverty by stratum and household size. But as the dimensions increase, the tables get more difficult to interpret. One way to investigate the many influences on poverty is through multivariate regression techniques and we present one such technique in this section.

We define a dichotomous variable (*pov*) which takes the value 1 for a poor household and 0 for one that is non-poor. Logit regression takes *pov* as its dependent variable and estimates the probability of poverty for any household with given characteristics. We apply (weighted) logit regression to all households in the 1995, 1997, 1999, 2002, and 2004 HIS, a total sample of 184,633 households. The explanatory variables are as follows:

- State dummy variables;
- Year dummy variables;
- Urban–rural dummy;
- Schooling (none, primary, secondary, tertiary);
- Employment status (employer/employee or otherwise);
- Ethnicity (Malay, Other Bumiputera, Chinese, Indian, Other);
- Number of adult equivalents (OECD definition);
- Age of head of household;
- Number of income recipients.

We treat these variables as exogenous determinants of poverty but this may not always be the case. For example imagine a head of household has a chronic sickness which prevents him from working. The employment status and poverty indicator will both reflect this, so employment status in our logit regression is strictly an endogenous variable. We proceed with our multivariate analysis treating these explanatory variables as exogenous.

The potential of logit regression is illustrated in Table 4.12. The table gives the probability that a household will be poor given its characteristics, some of which relate to the head of household. In 1995 the probability that a household would be poor in urban Johor if headed by an employed single Malay aged 30 with higher education is 0.001 or 0.1 per cent. This fell to 0.07 per cent in 2004. The 95 per cent confidence range gives some idea of the precision with which these probabilities are estimated. In the second row of the table, we report the probabilities for a similar household living in rural Johor where the head of household has only secondary schooling. The probabilities are substantially higher.

TABLE 4.12 Probability of Poverty by Household Characteristics*

Household Characteristics	1995 Probability	1995 95% Confidence Interval		2004 Probability	2004 95% Confidence Interval	
An employed single Malay aged 30 with higher education living in urban Johor.	0.0010	0.0006	0.0013	0.0007	0.0004	0.0009
An employed single Malay aged 30 with secondary education living in rural Johor.	0.0184	0.0160	0.0207	0.0130	0.0113	0.0147
An unemployed single Malay aged 30 with secondary education living in rural Johor.	0.0280	0.0239	0.0321	0.0198	0.0168	0.0228
Employed married Malay aged 30 with secondary schooling living in rural Johor. Wife and three children. Sole income earner	0.0567	0.0499	0.0635	0.0405	0.0354	0.0457
Employed married Malay aged 30 with secondary schooling living in rural Johor. Wife and three children. Both parents working	0.0239	0.0209	0.0269	0.0169	0.0147	0.0191
Employed married Malay aged 30 with secondary schooling living in rural Kelantan. Wife and three children. Sole income earner.	0.2302	0.2141	0.2463	0.1735	0.1607	0.1864
Employed married Kadazan Dusun aged 30 with secondary schooling living in rural Sabah. Wife and three children. Sole income earner.	0.3890	0.3702	0.4078	0.3090	0.2924	0.3255

* Logit Analysis, 1995–2004 HIS.

If the same head of household is unemployed, the probability of poverty rises from 1.3 per cent in 2004 to 2.0 per cent. From inspection of rows 4 and 5 of the table, we can appreciate the role of number of income earners. Consider a household in rural Johor headed by an employed married Malay aged 30 with secondary schooling, a wife and three children. If there is only one income earner, the probability of poverty in 2004 was just over 4 per cent, with a confidence interval of between 3.5 per cent and 4.5 per cent. If, in the same household, the wife also worked, the probability of poverty falls to 1.7 per cent (1.5 per cent–1.9 per cent confidence interval). In the last two rows of the table, we report the probabilities of poverty of particular households living in the relatively poor states: Kelantan and Sabah. In both cases, the probabilities are substantially higher. The probabilities of poverty are particularly high for a household in rural Sabah headed by a married Kadazan Dusun with secondary schooling, a wife, and three children, in which he is the sole income earner. For such a household, the probability of poverty in 2004 was over 30 per cent, with a narrow 95 per cent confidence interval of 29 per cent to 33 per cent.

Graphical Analysis: Malaysia, 1995–2004

In this section, we present two graphical presentations of income inequality and poverty in Malaysia over the period 1995–2004. These are Pen's Parade and the three 'Is' of Poverty (TIP) diagram.

Pen's Parade

Pen's Parade is closely related to the cumulative density functions (CDFs) discussed in Chapter 3. In its application to data from the HIS, we imagine that the height of the head of the household is proportional to the household's equivalized income.[61] The household heads then march past the observer, starting with the shortest and working upwards. Pen's Parade is a graph of the height of the parade as it passes against the proportion of all households that have already passed the observer. The parade is thus the inverse of the CDF.

To compare equivalized incomes for different years, the household's real income per adult equivalent is defined. We deflate gross nominal income per adult equivalent using food and non-food CPI indices by year, region, and stratum. The food and non-food weights were defined by the shares of food and non-food components of each household's PLI.

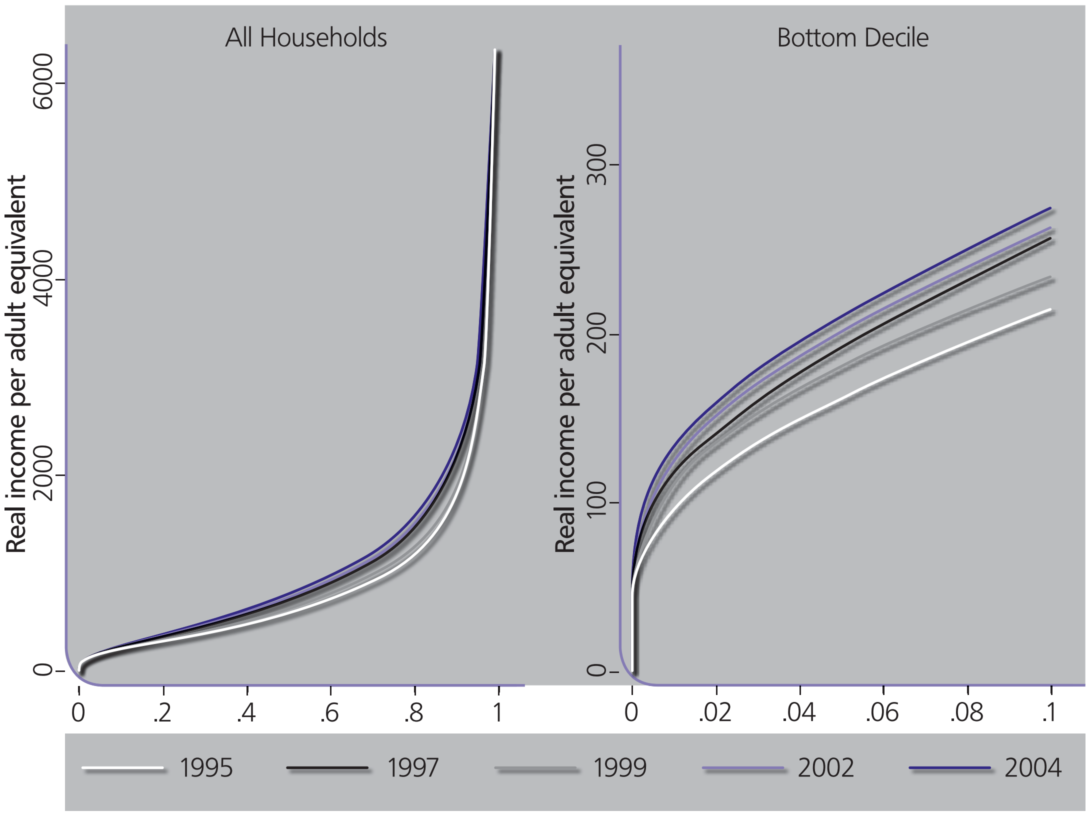
Pen's Parade for each HIS is graphed as Figure 4.1. The sample of each HIS is trimmed at the top end by removing the top 1 per cent of income earners as these distort the graph. Pen's Parade for all remaining households is graphed on the left panel of the figure. This is the dwarves and giants plot. In the analysis of poverty, it would be more helpful if we focused on the parade at the lower end of the distribution—say the bottom 10 per cent of households. This part of the parade is graphed in the right panel of Figure 4.1. Apart from the recession year 1999, the 'heights' of household heads are higher than those of the preceding year.

One way to use the graphs is to see what happens to the poverty rate as we change the PLI. The incidence of poverty is obtained simply by reading off the proportion (on the *x*-axis) corresponding to the PLI defined on the *y*-axis. Because the lines do not intersect, it follows

[61] For Pen's Parade, our income measure is the household's real income divided by the number of equivalized adults using the simple OECD weights discussed earlier.

that the ranking of years by poverty incidence is unaffected by the choice of PLI. If the PLI per adult equivalent were RM200 per month, the incidence of poverty would be lower in each successive year except 1999. If the PLI were RM150 per month, the incidence of poverty would obviously be lower in each year but they would still decline over time (with the exception of 1999). The fact that Pen's Parade graphs do not intersect means that the decline in incidence we observe is robust to variations in the selected PLI.

FIGURE 4.1 **Pen's Parade: Malaysia, 1995–2004**



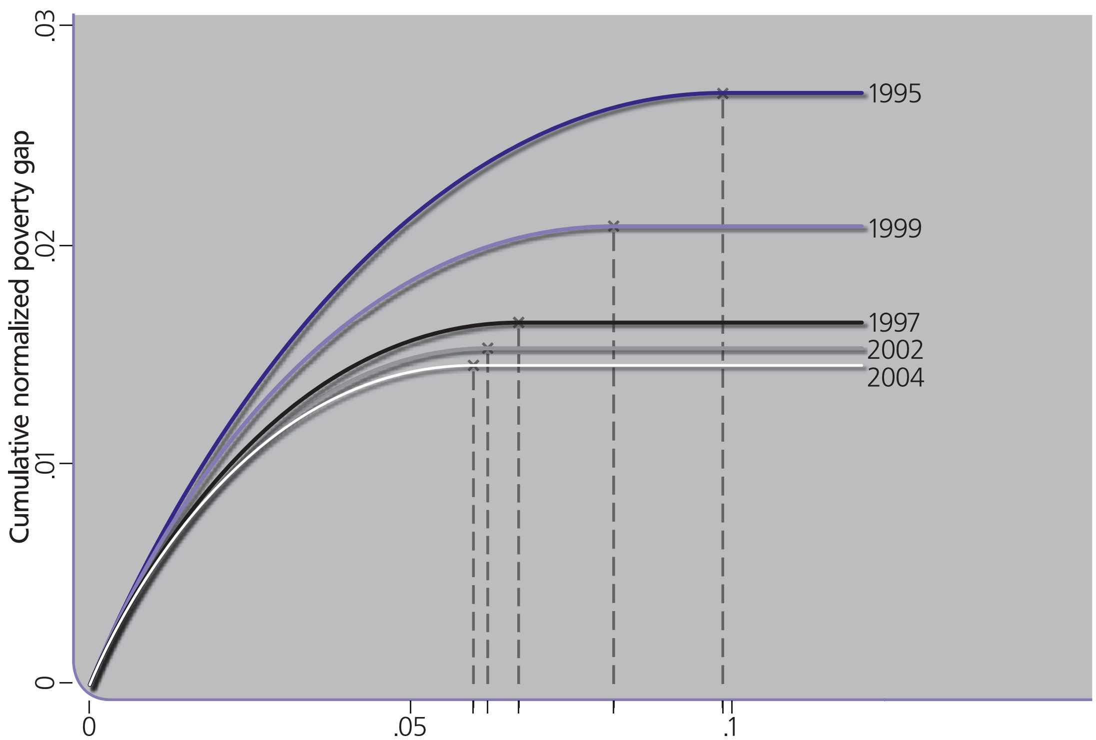
TIP Diagram

The TIP diagram is formed by first ranking households from the poorest to the richest (by their normalized poverty gaps), cumulating the normalized gaps, and plotting the cumulative per capita values against the cumulative share in the population. The resulting graph displays the incidence of poverty on the *x*-axis (where the TIP curve becomes horizontal) and the intensity of poverty (P_1) on the *y*-axis (again where the TIP curve becomes horizontal). For these graphs, we use the 2005 methodology. The normalized poverty gap for each household *i* is defined as

$$\Gamma(y_i, z_i) = \max\left(\frac{z - y_i}{z_i}, 0\right)$$

For the non-poor, the gap is zero and for the poor, the gap is the household's income distance from its PLI (defined here as z_i). TIP curves for 1995–2004 are presented in Figure 4.2.

FIGURE 4.2 **TIP Curves: Malaysia, 1995–2004**



The graph displays visually the trends in Malaysia's poverty measures since 1995. The first 'I', incidence, has declined in every year, with the exception of 1999. The second 'I', intensity, is the point on the *y*-axis where the TIP curves become horizontal. Intensity follows incidence, falling in every year save 1999. The third 'I' is inequality and is displayed by the curvature of the lines which again declines with each successive year save 1999.

Summary of Results

The following summarizes the main findings of our analysis of Malaysian poverty over the period 1995–2004:

- By the revised 2005 PLI, the incidence, depth, and severity of poverty have declined over time, with the exception of 1999 when incomes were affected by the severe recession associated with the Asian financial crisis.

- The proportion of all Malaysian households in poverty was 5.96 per cent in 2004. However, this figure masks substantial variation across the country's states, communities, and between rural and urban areas.
- Poverty is particularly concentrated in the five low income states. In 2004 there were 5,459.4 thousand households in Malaysia, 5.96 per cent of which were poor—over 325,000 households. Three quarters of these households live in the five poorest states: Kedah, Kelantan, Terengganu, Sabah, and Sarawak. Of poor households in 2004, 37 per cent live in Sabah. Poverty in Malaysia is increasingly a regional problem.
- Poor households also tend to be the larger ones, so the individual and child poverty rates are above the proportions of poor households. In 2004 the proportion of Malaysian children in poor households was over 12 per cent. The proportion of poor children in Sabah was over 40 per cent.
- Relative poverty rates have tended to be constant over time. Roughly 1 in 5 households received an equivalized income less than half the Malaysian median income.

5 MEASURING INCOME INEQUALITY: MALAYSIA, 1995–2004

MEASURING INCOME INEQUALITY: MALAYSIA, 1995–2004

Our focus to this point has been on poverty—that is, on incomes at the lower end of the distribution. This chapter examines the Malaysian income distribution more widely, using Household Income Surveys (HIS) between 1995 and 2004. Concern over the widening disparities in incomes has led to specific targets for reducing inequality in Malaysia. The Ninth Malaysia Plan (9MP) sets out its aims in these terms:

> Efforts to improve income distribution will focus on reducing income disparity between Bumiputera and non-Bumiputera ethnic groups, between rural and urban areas and increasing income of those in the bottom 40 per cent income bracket. (EPU 2006: 35)

The share in income of the bottom 40 per cent actually fell from 14 per cent in 1999 to 13.5 per cent in 2004, while that of the top 20 per cent increased from 50.5 per cent to 51.2 per cent over the same period. Aiming to reverse these recent trends, Malaysia's policy is summarized in the catchphrase, 'growth with distribution'.

This chapter aims to analyse income distribution[62] using the HIS since 1995. This is no easy task: how can an entire distribution be distilled into simple measures that can be easily interpreted and applied?

The chapter begins by examining the distribution of household income graphically (frequency distributions, Lorenz curve, and Generalized Lorenz curve). After sketching some properties that are desirable for *inequality indices,* a number of widely used measures are considered: the coefficient of variation, decile ranges, the Gini coefficient, Atkinson and Generalized Entropy indices, and the Sen index.

Questions which this chapter seeks to address include the following: 'How has income inequality changed in Malaysia since 1995?' and 'What are the main factors responsible for the unequal distribution of income?' 'How do different measures of income inequality inform public policies?'

Income Distribution Graphs

A helpful (and basic) starting point in any analysis of income distribution is to view the data graphically. In Chapter 3, we considered the cumulative distribution function (CDF) and the related Pen's Parade diagram, though there our focus was on income at the lower end of its distribution. Rather than plot the *cumulative* distribution function, it is possible to graph the distribution (or density) function itself. This can be done by drawing a histogram of household income, with the height of each column reflecting the proportion of households in each 'bin' or income class. A refinement of this approach is to use 'kernel density' estimation of the distribution function, essentially a statistical technique that gives a 'smoothed histogram'.

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[62] For helpful surveys of inequality measurement, see Cowell (1995), Jenkins (1991), and Duclos and Abdelkrim (2006). For a recent analysis of long-term inequality trends in Malaysia, see Zainal (2001, 2005) and Leete (2007).

Figure 5.1 presents a kernel density estimate[63] of the distribution of monthly household income per adult equivalent amongst Malaysian households in 2004. The number of adult equivalents in the households is defined using the OECD adult equivalent scale: the first adult is counted as one, each additional adult counts as 0.7, and children are weighted by 0.5. So a family of two adults and three children are equivalent to 1 + 0.7 + 3x0.5 = 3.2 'equivalent adults'. We will refer to income per adult equivalent as 'equivalized household income'. Because of the distorting effect of some very high income earners in the sample, we trimmed the sample to omit the top 1 per cent of income earners and graphed the distribution of the remaining 99 per cent. The distribution for Malaysia is very typical: highly skewed to the right, with a long upper tail. The mean of the untrimmed sample is shown by the blue dashed line and it is clear that the mean is higher than the median (dashed black line) and both are above the mode (the peak of the distribution function).

FIGURE 5.1 **Distribution of Household Income Per Adult Equivalent: Malaysia, 2004**

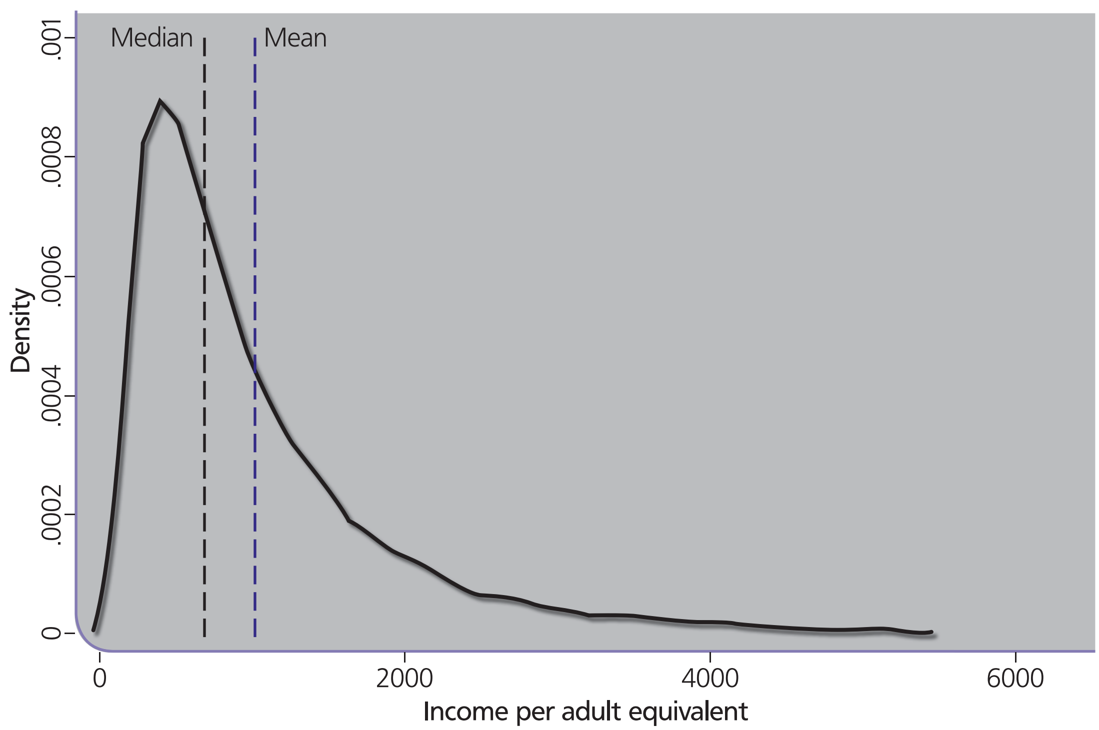
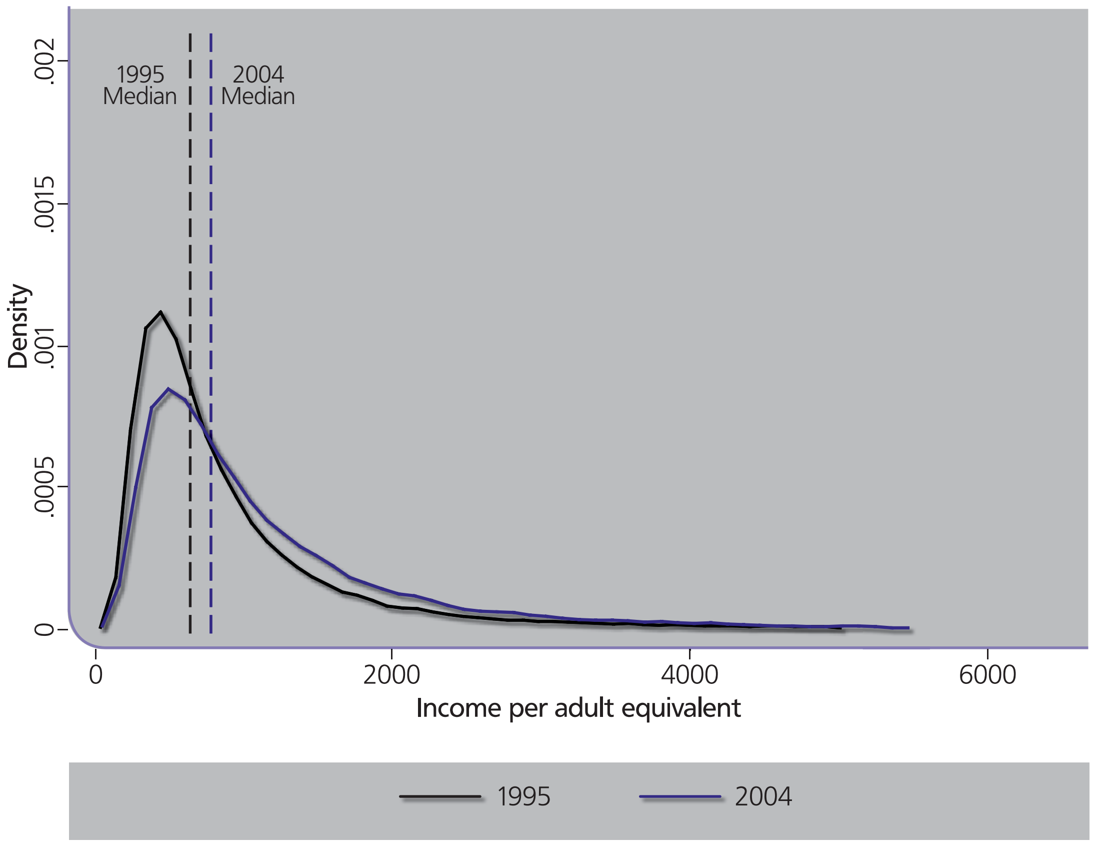


Figure 5.2 shows trimmed distributions over two HIS datasets: 1995 and 2004. Equivalized household incomes are all expressed in 2004 prices by deflating household incomes using the national consumer price index (CPI). The 1995 (black) and 2004 (blue) distributions demonstrate

[63] For the technically minded, in Figure 5.1 and elsewhere in this chapter, we apply weighted density estimates using the Epanechnikov kernel with the bandwidth optimally determined.

the distribution functions are less peaked and more dispersed in 2004. The distributions show that the proportions of households with low incomes have declined (as we observed in Chapter 4) and the proportions with incomes above the median have increased over time. Figure 5.2 displays graphically the emergence of a growing middle class in Malaysia.

FIGURE 5.2 **Income Distribution: Malaysia, 1995–2004**

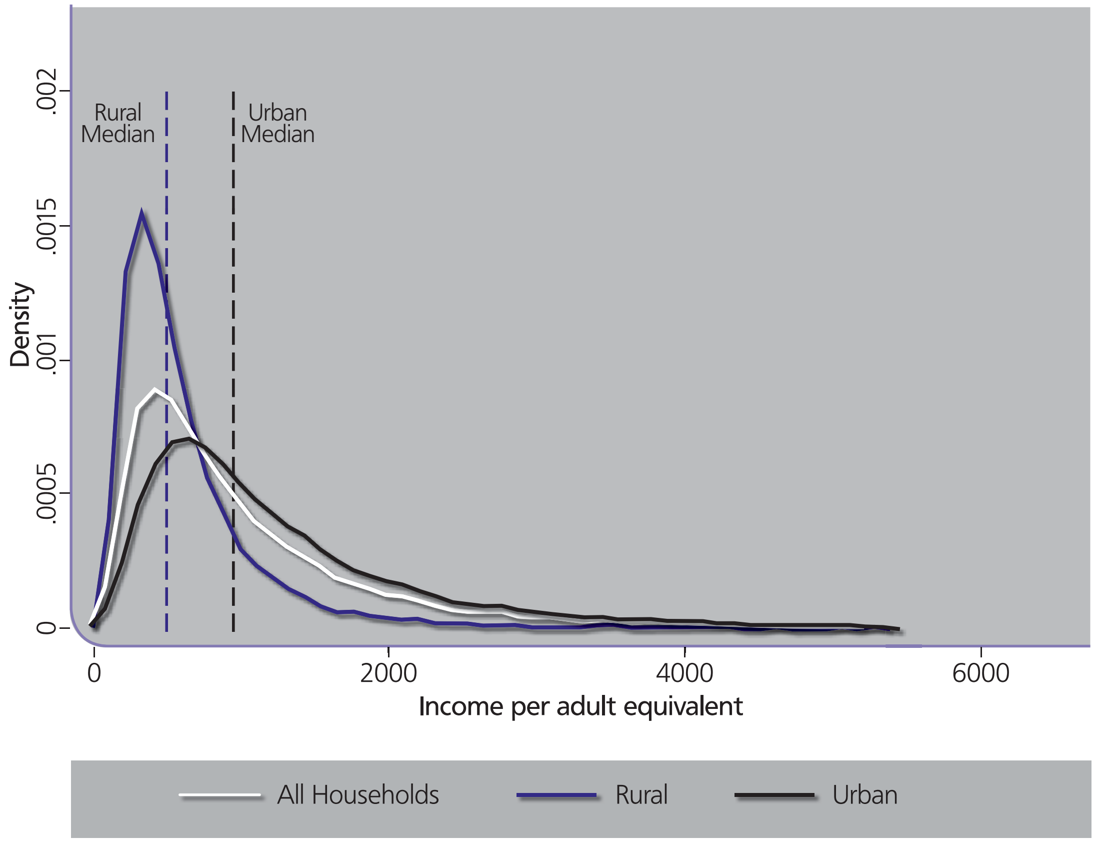


The density graphs can also be used to compare distributions across different subgroups of households at a point of time. In Figure 5.3 we graph urban (in black) and rural (blue) income distributions for the year 2004.[64] The median incomes of the (untrimmed) samples for urban and rural households are shown by the dashed lines (in matching colour). Two features of the figure stand out. The median equivalized income of urban households (RM940 per month) is significantly above that for rural households (RM482), reflecting both lower household incomes in rural areas and larger household size.[65] Secondly, incomes in urban areas have a flatter and less peaked distribution.

[64] We have again trimmed the top 1 per cent earners from the sample.

[65] Larger households typically have more dependants, raising the denominator (number of adult equivalents) but making no contribution to the numerator (household income).

FIGURE 5.3 **Urban–Rural Income Distributions: Malaysia, 2004**



Lorenz Curve

A graphical device that is more widely used is the Lorenz Curve. This curve plots the *cumulative proportion of income* earned by the poorest *p* per cent of the population for different values of *p*. Notationally, we will refer to this curve by the function *L*(*p*).

In Table 5.1 we construct the data for a Lorenz curve using the hypothetic sample of 30 individuals we described in Chapter 3 (see Table 3.1). First, we sort the observations (individuals) in ascending order of income: thus in column (3) the first sorted observation is the poorest individual, #10, with an income of US$100. Individual #29 is next with an income of US$134 and so on. The last observation is the richest person (#11, with an income of US$2,191). Summing over all incomes, we obtain the sample *aggregate* income of US$23,832.

Each individual has a population share of 1/30, or 3.333 per cent. Cumulating 3.333 per cent over successively richer individuals gives the cumulative population share (*p*). Individuals #10 and #29 together have a total population share of 3.333 x 2, or 6.67 per cent. The poorest 3 individuals have a population share (*p*) of 10 per cent and all 30 individuals have a population share of 100 per cent. Because the data are sorted in ascending order of income, the poorest

TABLE 5.1 **Hypothetical Lorenz Curve Calculations**

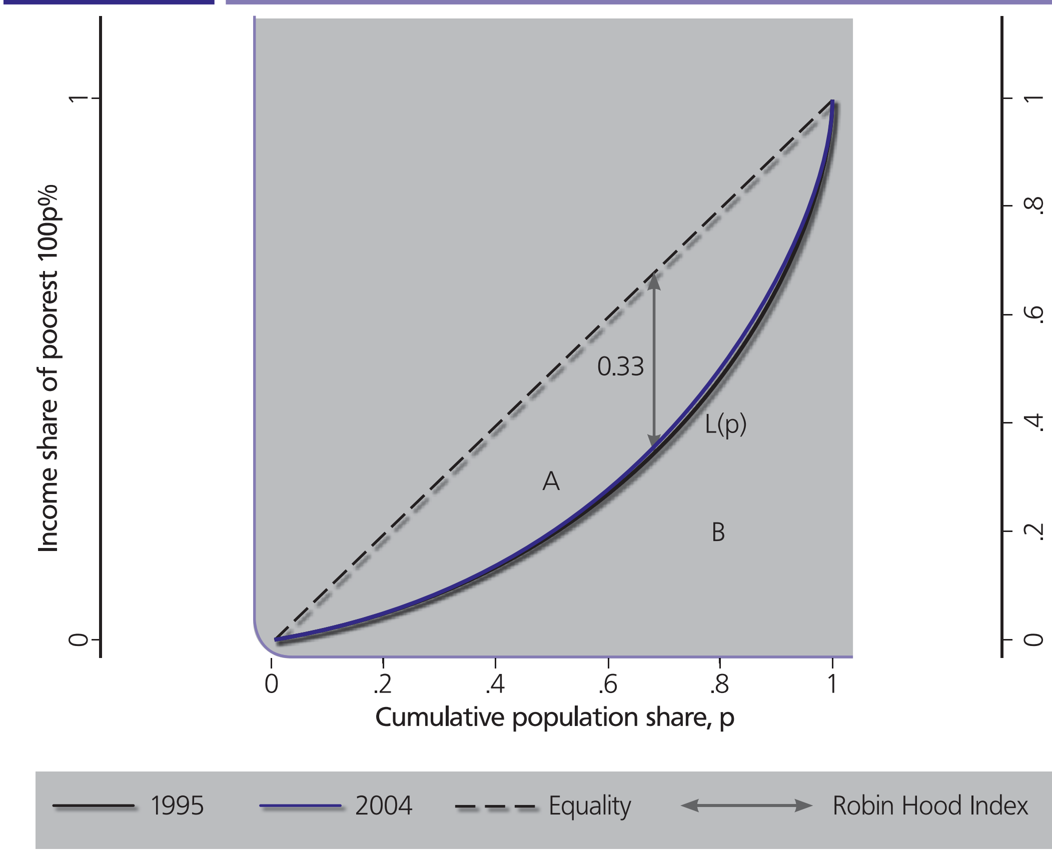
(1) Individual #	(2) Income y	(3) Sorted by Income #	(4) y	(5) Cumulative Percent of Population (Col (1) ÷ 30)% p	(6) Cumulative Income	(7) Cumulative share of total income (Col(6) ÷ 23,832)% L(p)
1	1,115	10	100	3.33	100	0.42
2	1,583	29	134	6.67	234	0.98
3	775	23	150	10.00	384	1.61
4	720	26	312	13.33	696	2.92
5	835	7	334	16.67	1,030	4.32
6	771	17	499	20.00	1,529	6.42
7	334	16	501	23.33	2,030	8.52
8	1,106	20	550	26.67	2,580	10.83
9	878	14	571	30.00	3,151	13.22
10	100	12	622	33.33	3,773	15.83
11	2,191	13	658	36.67	4,431	18.59
12	622	28	682	40.00	5,113	21.45
13	658	25	692	43.33	5,805	24.36
14	571	19	698	46.67	6,503	27.29
15	921	24	704	50.00	7,207	30.24
16	501	4	720	53.33	7,927	33.26
17	499	6	771	56.67	8,698	36.50
18	999	3	775	60.00	9,473	39.75
19	698	5	835	63.33	10,308	43.25
20	550	27	843	66.67	11,151	46.79
21	1,663	9	878	70.00	12,029	50.47
22	1,061	15	921	73.33	12,950	54.34
23	150	18	999	76.67	13,949	58.53
24	704	22	1,061	80.00	15,010	62.98
25	692	8	1,106	83.33	16,116	67.62
26	312	1	1,115	86.67	17,231	72.30
27	843	30	1,164	90.00	18,395	77.19
28	682	2	1,583	93.33	19,978	83.83
29	134	21	1,663	96.67	21,641	90.81
30	1,164	11	2,191	100.00	23,832	100.00
Total Income:			**23,832**			

individual will account for less that 3.33 per cent of total income. In our example, her income share is only 0.4 per cent (see column (7)). The share of income going to the poorest two persons will be less than 6.67 per cent—in fact, only 0.98 per cent. The cumulative share of income ($L(p)$) will thus be less than the cumulative population share (p), unless incomes are *perfectly equally distributed*: in this case $L(p) = p$. The Lorenz curve is simply a plot of column (7) against column (5).

When applied to the HIS household data, p is the cumulative proportion of *households*, where these households have been ranked from the poorest to the richest according to their equivalized household income. Thus $L(p)$ is the cumulative share of total equivalized income. In Figure 5.4, we present the Malaysian Lorenz curve using HIS data for 1995 and 2004.

If every household enjoyed the identical equivalized income, then the bottom p per cent of households would receive p per cent of total household income. In this case, the Lorenz curve would be a 45° straight line, shown in Figure 5.4 as the dashed line labelled 'Equality'. Of course incomes are unequally distributed, so the lowest p per cent will typically earn less than p per cent of total income, shown by the function $L(p)$. The greater that share, the more equal is the distribution of income. The share in total income of the *richest* p proportion of the population is given by $1 – L(p)$; the greater that share, the more *unequal* is the distribution of income.

FIGURE 5.4 **Lorenz Curves: Malaysia, 1995 and 2004**



In Malaysia, in 2004 the poorest 1 per cent of households actually earned 0.1 per cent of total equivalized income; the poorest 10 per cent received 1.8 per cent of total income and the poorest 50 per cent received just less than 20 per cent of total income. Also, in 2004 the richest 10 per cent of households received 35 per cent of equivalized household income. So far from being a straight line, a typical Lorenz curve is bowed downwards, its gradient increasing as we plot the shares of ever richer households.

The striking feature of Figure 5.4 is the very small change in the position of the Lorenz curve between 1995 and 2004. The curve for 2004 is closer to the equality line, though the differences are barely visible. The changes in the distribution functions presented in Figure 5.2 make little impact on the Lorenz curves. The areas beneath the distribution functions to the left of the medians give the proportions of total income earned by households with income less than the median. These income shares at the median were 19.45 per cent in 1995 and 19.76 per cent in 2004. Thus although the distribution functions plotted in Figure 5.2 have changed, their impact on the Lorenz curves is marginal.

Drawing conclusions from Lorenz curves as close together as these is complex: it requires some summary statistical measures of the area between the curves and the equality line to determine whether income distributions are closer to or further away from equality. The Gini coefficient does just that. When we track the behaviour of the Gini over time, we will be able to measure changes in the Lorenz curves which cannot be easily detected through inspection of the graphs.

Gini Coefficient

To provide some indication of whether income inequality is increasing or decreasing, analysts often summarize complex distributions in an inequality index of some kind. We will examine and apply such *indices of inequality* later in this chapter but our discussion of the Lorenz curve would not be complete without discussion of the Gini coefficient,[66] perhaps the most widely used of all indices and the less widely used 'Robin Hood' index. The area between the Lorenz curve and the equality line divided by the total area under the equality line gives the Gini coefficient. Its value lies between zero (perfect equality) and one (perfect inequality, where one household earns all income)—higher values indicating greater inequality. Graphically, it is the area A in Figure 5.4 expressed as a proportion of the area A+B.

For the hypothetical data set of Table 5.1, the formula for the Gini is

$$G = \frac{1}{n}\left[n + 1 - 2\left(\frac{\sum_{i=1}^{n}(n+1-i)y_i}{\sum_{i=1}^{n}y_i}\right)\right]$$

where n is the number of individuals (30 in our example) and y_i is the income of an individual who occupies the ith row of the sorted income data. The income of the poorest individual is y_1 and that of the richest is y_{30}. The calculation of the Gini is illustrated in Table 5.2. The values of $(n + 1 - i)\, y_i$ for each individual are in column (5) and at the foot of this column is their sum ($263,254). The sum of incomes ($\sum_{i=1}^{n} y_i$) is at the foot of column (2) ($23,832). For our hypothetical data, the Gini is therefore

$$G = \frac{1}{30}\left[30 + 1 - 2\left(\frac{263{,}254}{23{,}832}\right)\right] = 0.2969$$

[66] The Gini coefficient is named after the Italian statistician and demographer, Corrado Gini. He developed the coefficient that bears his name in Gini (1921).

TABLE 5.2 **Calculation of the Gini**

(1)	(2)	(3)	(4)	(5)
#	*y*	*Row Number i*	*n+1-i*	*(n+1-i)y*
			31-Col(3)	*Col(4) x Col(2)*
10	100	1	30	3,000
29	134	2	29	3,886
23	150	3	28	4,200
26	312	4	27	8,424
7	334	5	26	8,684
17	499	6	25	12,475
16	501	7	24	12,024
20	550	8	23	12,650
14	571	9	22	12,562
12	622	10	21	13,062
13	658	11	20	13,160
28	682	12	19	12,958
25	692	13	18	12,456
19	698	14	17	11,866
24	704	15	16	11,264
4	720	16	15	10,800
6	771	17	14	10,794
3	775	18	13	10,075
5	835	19	12	10,020
27	843	20	11	9,273
9	878	21	10	8,780
15	921	22	9	8,289
18	999	23	8	7,992
22	1,061	24	7	7,427
8	1,106	25	6	6,636
1	1,115	26	5	5,575
30	1,164	27	4	4,656
2	1,583	28	3	4,749
21	1,663	29	2	3,326
11	2,191	30	1	2,191
Sum:	**23,832**			**263,254**

$$G = \frac{1}{n}\left[n + 1 - 2\left(\frac{\sum_{i=1}^{n} (n+1-i) y_i}{\sum_{i=1}^{n} y_i} \right) \right]$$

(1/30) x [31-2x(263,254 / 23,832)]

= 0.2969

For equivalized incomes in the 2004 HIS, the Gini coefficient is 0.458. We investigate the behaviour over time of the Gini later in this chapter when we examine a wider range of inequality indices.

The Robin Hood Index

An informative but less well-known index of inequality is given by the *proportion of total income* that would need to be reallocated across the households to achieve perfect equality in income. This is called the Schuz coefficient, the Pietra-ratio, or (more colourfully) the 'Robin Hood Index'.[67] It tells us the fraction of total household income required for the 'rich to give to the poor' to achieve perfect equality. The Schuz coefficient can be shown graphically to be the maximum distance between the line of equality and the Lorenz curve. The maximum value of $p - L(p)$ is attained where the slope of $L(p)$ is 1 and this is true when $p = p_m$ where p_m is the proportion of households earning less than the mean. In 2004 the proportion of households earning less than the mean equivalized income was around 68 per cent ($p = 0.68$) and $L(0.68)$ was 35 per cent—the poorest 68 per cent of households received 35 per cent of total income. The Robin Hood index for 2004 is therefore 68 per cent – 35 per cent = 33 per cent. To achieve perfect equality of incomes, 33 per cent of total income would have to be transferred from richer households to poorer ones. It is displayed graphically in Figure 5.4.

The Robin-Hood coefficient is an example of a more general class of *mean-preserving income-equalizing* transfers of income called Pigou-Dalton transfers. They require income transfers from a richer person (of percentile r, say) to a poorer person (of say percentile $q < r$) that keep *total income* constant. Indices of inequality which do not increase (and sometimes decrease) as a result of such equalizing transfers are said to obey the Pigou-Dalton principle of transfers. These equalizing transfers have the effect of moving the Lorenz curve unambiguously closer to the line of perfect equality. This is because such transfers do not affect the value of $L(p)$ for all p up to q and for all p greater than r, but they increase $L(p)$ for all p between q and r.

Generalized Lorenz Curve

The Generalized Lorenz curve is the Lorenz curve *scaled up at each point* by the overall mean income. It is defined as

$$GL(p) = \mu \cdot L(p)$$

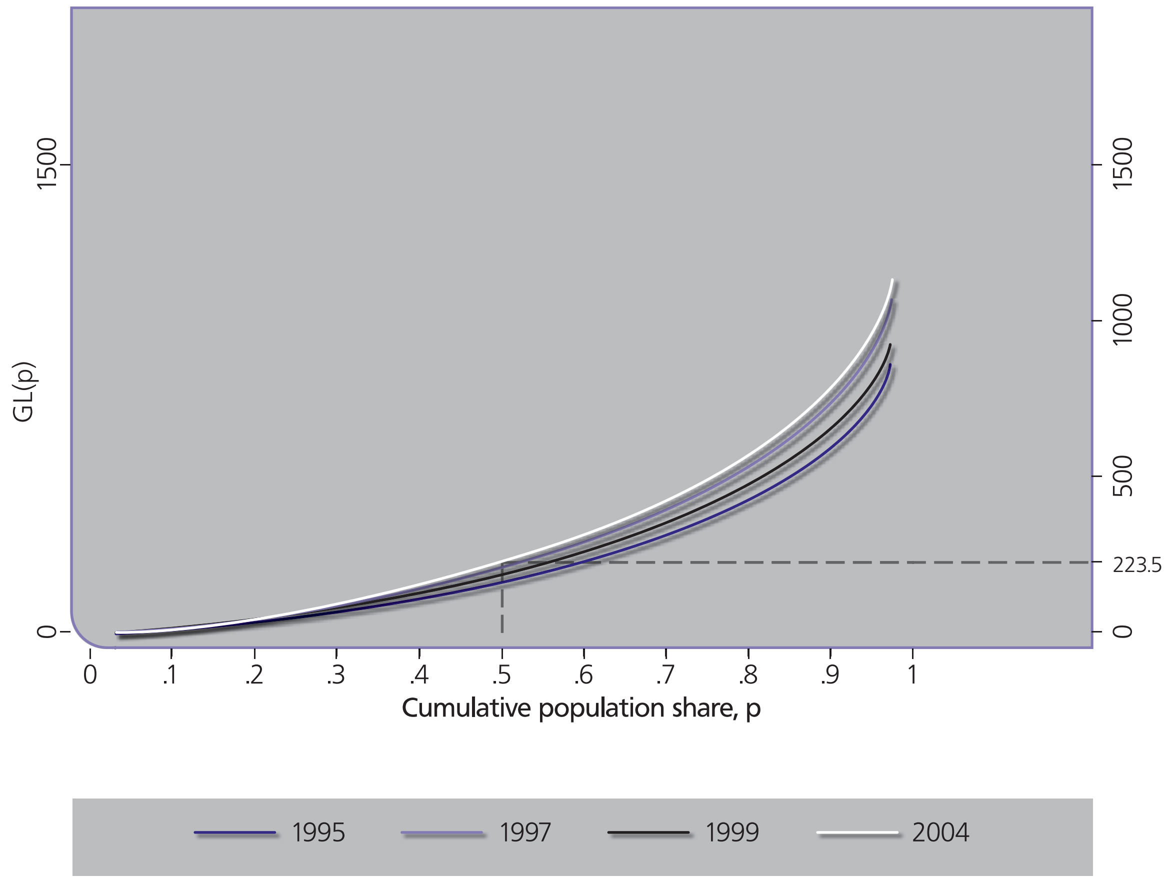
where μ is mean (equivalized) incomes over all households. $GL(p)$ gives the absolute contribution to average income of the bottom p proportion of households. Mean equivalized income in 2004 was RM1,131 and the poorest 50 per cent of households earned 19.76 per cent of total income, so $L(0.5) = 0.1976$. The value of the Generalized Lorenz curve at $p = 0.5$ is

$$GL(0.5) = \mu \cdot L(p) = 1131 \text{ x } 0.1976 = 223.5$$

The intuitive interpretation of GL is straightforward enough. Our value for $GL(0.5)$ means that average household income would fall to RM223.5 if the richest 50 per cent of households were suddenly to retire or earn no income. Note that $GL(p)$ divided by p gives the average income of the poorest p proportion of households. For $p = 0.5$, this is RM447 in Malaysia in 2004, around 40 per cent of mean income.

[67] See Schutz (1951) and Kondor (1971).

FIGURE 5.5 Generalized Lorenz Curves: Malaysia, 1995–2004



Generalized Lorenz curves for Malaysia are graphed in Figure 5.5. The means of real equivalized household income are the values of *GL* at $p = 1$ and it is clear from the graph that mean real incomes have risen over the period, with the exception of 1999. [68] The curves do not intersect, so the mean incomes of all percentiles have risen over the period with the exception of 1999. The 2004 value of *GL*(0.5) which we derived above for 2004 is shown in the figure.

Inequality Indices

The graphical techniques reviewed provide a vivid picture of the distribution of income in Malaysia. A key lesson from the figures is the fact that all percentiles have benefited from Malaysia's increasing prosperity over the period—the CDFs, Lorenz and Generalized Lorenz curves do not intersect—a feature referred to as 'first-order dominance'. Of course it is harder to appreciate from the graphs whether some percentiles (say poorer households) benefit more or less than others (the richer ones). A clearer picture of overall income distribution may

[68] Nominal incomes were converted to real values by deflating with the national CPI.

be obtained summarizing the distributions through the use of *indices of inequality*, of which the Gini and Schuz coefficients are examples. Economists have developed a very large number of such indices—unsurprising given the complexity of the distributions they are attempting to summarize in a single number. In the rest of this chapter, we review some of the more important indices and apply them to Malaysian household income data.

Axioms of Inequality Measures.

As with poverty, there appears to be general agreement that indices of inequality should satisfy desirable axioms, including the following:

Symmetry:
The measure should be unaffected if two persons switch incomes. This clearly implies that our measure requires 'anonymity'.

Mean Independence:
If the incomes of all individuals (or households) changed by the same proportion, the value of the index should remain unaffected.

Population Independence:
If two or more identical populations are pooled, the index should be unchanged.

Transfer:
A regressive transfer (one from a poorer individual to a richer one) which does not reverse their relative ranking should increase the index.

And as with poverty, it is often helpful to have

Decomposability:
If there exist non-overlapping and exhaustive subgroups, aggregate inequality can be expressed as a weighted sum of the same index for different groups ('within-group' component) plus the value of the index if the income of every person in each group is equal to the mean income of that group ('between-groups' component).

Coefficient of Variation

The simplest inequality measure is the standard deviation or variance of income across households in our samples. Unfortunately, it violates the core axiom of mean independence. If everyone's income were to rise by the same proportion—say a 5 per cent increase for all—the standard deviation would also rise by 5 per cent. Tracking inequality over time would be made difficult if the index selected changes with the mean. The problem is due to the fact that the standard deviation of income (σ)[69] is measured in monetary units (e.g. ringgit). One obvious solution is to divide the standard deviation by the sample mean income (μ) to derive a measure that is metric free. This is the 'coefficient of variation' (*CV*) defined as $CV = \frac{\sigma}{\mu}$.

Percentile Ratios

Another metric-free measure that is quite widely used is the ratio of incomes at two selected percentiles of the distribution. Often chosen are the 90th and 10th percentiles (*p*90/*p*10). The numerator of the ratio is the highest income earned by the poorest 90 per cent of households (equivalently the lowest income of the richest 10 per cent of the population) and the denominator is the highest income earned by the poorest 10 per cent of households. If incomes were equally distributed, this number would be 1. A higher value for the ratio indicates higher levels of income inequality. Of course, this statistic compares incomes at only two points in the distribution so it is a rather selected statistic. As the choice of percentiles is arbitrary, in what follows we also consider the less extreme 75–25 ratio (*p*75/*p*25).

Table 5.3 shows some summary statistics for real equivalized household income. Apart from the mean and median, all statistics shown are measures of dispersion. The coefficient of variation (CV) showed a marked fall in 1999 (the year when the Asian crisis had the greatest impact on our survey data) and an equally marked rise in 2004.[70] The income share of the bottom 40 per cent (which is an explicit target of Malaysia's latest five-year plan) also rose in 1999. By 2004 it was very close to its 1995 level. The wider of the two percentile ratios fell in 1999 but is otherwise fairly constant over time. The *p*75/*p*25 ratio, covering households either side of, but close to, the median is also largely unchanged over time.

TABLE 5.3 Summary Statistics: Malaysia, 1995–2004*

Measure	1995	1997	1999	2002	2004
Mean (μ)	873.5	1077.2	932.4	1092.5	1131.3
Median	576.1	707.1	637.8	738.5	769.5
Standard Deviation (σ)	1062.0	1370.7	1057.6	1403.6	1788.0
CV	1.2158	1.2725	1.1344	1.2847	1.5804
Income Share (%) of Bottom 40%	13.47	13.18	14.06	13.41	13.63
*p*90/*p*10	8.3380	8.5620	7.8670	8.4130	8.2320
*p*75/*p*25	2.9790	3.0770	2.9550	3.0850	3.0630
Gini	0.4684	0.4729	0.4508	0.4631	0.4580
Robin Hood Index	0.3411	0.3442	0.3277	0.3366	0.3329
Gini (Household Income)	0.4617	0.4717	0.4523	0.4629	0.4619

*Real equivalized household income.

69 The standard deviation is defined as $\sigma = \sqrt{\frac{1}{N}\sum_{i=1}^{N}(y_i - \mu)^2}$ where *N* is the number of households, *y* the equivalized income, and μ the mean income over all households. Strictly speaking, this is an *estimate* of the true standard deviation using a sample of *N* observations.

70 We shall later observe that the increase in the CV in 2004 is largely due to one very rich household in the sample.

The Gini coefficient changed little over the period, falling in the crisis year 1999.[71] Its value in 2002 was very close to the 1995 value and it fell to 0.458 in 2004. These variations are reflected in the Schuz (or Robin Hood) ratio, which remains fairly constant at one third over the period, falling to its lowest level in 1999. To perfectly equalize all incomes by mean-preserving transfers would require transfers of around one third of total household incomes. The last row of Table 5.3 shows the Gini coefficient for household income—not equivalized by expressing it in per adult equivalent terms. This is the Gini coefficient published in Malaysia's Five-Year Plans. [72] Like the Gini for equivalized income, this coefficient also fell marginally in 2004.

Since the distance between the Lorenz Curve and the line of perfect equality is greatest in the middle of the distribution (i.e. close to the median), the Gini coefficient is known to be particularly sensitive to changes in income distributions close to the median, as are the Schuz and *p*75/*p*25 ratios, which have similar patterns over time as the Gini. These measures are not very sensitive to income distribution changes in the tails of the distribution.[73]

The Atkinson and Generalized Entropy Indices

Statistical indices like the standard deviation or the CV take no account of precisely where in its distribution income is unequally distributed. For example, the standard deviation is the square root of the average squared difference of each income from the mean (see footnote 69 above). It contains the terms $(y_i - \mu)^2$—the square of the deviation of the ith individual's income from the overall mean. An individual with income RM1,000 *below* the mean contributes the same to this measure as one with income RM1,000 above the mean. The approaches we now consider allow the indices of inequality to put differential weights on incomes above and below the mean. The Atkinson[74] and Generalized Entropy[75] inequality indices have this feature.

Atkinson Inequality Indices (*A*)

$$A_\varepsilon = 1 - \left[\frac{1}{N} \sum_{i=1}^{N} \left(\frac{y_i}{\mu} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}, \ \varepsilon \geq 0, \varepsilon \neq 1$$

$$A_\varepsilon = 1 - \exp \left[\frac{1}{N} \sum_{i=1}^{N} \log \left(\frac{y_i}{\mu} \right) \right], \ \varepsilon = 1$$

---

[71] Over a longer time frame, income inequality as measured by the Gini declined steadily from the 1970s until 1990 and has remained roughly constant subsequently. See Leete (2007) for a fuller discussion.
[72] See, for example, Table 16-3 in EPU (2006).
[73] It is possible to attach weights that vary with *p* when calculating the areas A and B in Figure 5.4. This is the approach used in the S-Gini coefficient. See Duclos and Abdelkrim (2006) for details.
[74] Atkinson (1970) based his measure of inequality on an index of what economists call 'social welfare'—an attempt to measure whether society *as a whole* is better off. We present the details of his approach in the Appendix.
[75] The term entropy is borrowed from information theory where 'Shannon entropy' or information entropy is a measure of the uncertainty associated with a random variable.

Generalized Entropy (*GE*) Inequality Indices (*I*)

$$I_\theta = \left(\frac{1}{\theta(\theta - 1)}\right)\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\mu}\right)^{\theta} - 1\right], \theta \neq 0,1$$

$$I_1 = \frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\mu}\right)\log\left(\frac{y_i}{\mu}\right), \theta = 1$$

$$I_0 = \frac{1}{N}\sum_{i=1}^{N}\log\left(\frac{\mu}{y_i}\right), \theta = 0$$

These indices place differential weights on the contributions of incomes below and above the mean through the choice of their respective parameters: ε in the case of *A* and θ in the case of *I*. To see how this works, we present, in Table 5.4, details of the calculation of both indices for our hypothetical income data. The rows are sorted in ascending order of income, with the poorest individual in the first row, and so on. The ratio of each individual's income to the overall mean income is given in column (3). The income of poorest individual #10 is only 12.6 per cent of the mean; the income of the richest individual is 2.8 larger than the mean; and individual #3 has an income ($775) very close to the mean ($794). These ratios are central to both *A* and *I* indices.

In the Atkinson case, the index is raised to the power (1-ε) and this term is then averaged over all individuals. When $\varepsilon > 1$, more weight is given to the poorest individuals. For example, with $\varepsilon = 2$ (in column (4)), individual #10 contributes 7.944 to the index whereas the richest individual contributes only 0.363. When $\varepsilon < 1$ (say 0.5 as in column (5)), the reverse applies: individual #10 only contributes 0.355 to the index whereas the richest individual contributes 1.66. By varying ε we can make the index sensitive to income dispersion at different parts of its distribution. For this reason, ε is sometimes called the degree of 'inequality aversion'. The larger its value, the more sensitive the index will be to income dispersion at the bottom of the income distribution; smaller values will make the index more sensitive to dispersion at the top.

TABLE 5.4 **Calculation of the *A* and *I* Indices**

(1) Individual #	(2) Income y	(3) $\frac{y_i}{\mu}$	(4) Atkinson Index (P) $\varepsilon = 2$	(5) $\varepsilon = 0.5$	(6) Generalized Entropy (I) $\theta = -1$	(7) $\theta = 2$
10	100	0.126	7.944	0.355	7.944	0.016
29	134	0.169	5.928	0.411	5.928	0.029
23	150	0.189	5.296	0.435	5.296	0.036
26	312	0.393	2.546	0.627	2.546	0.154
7	334	0.420	2.378	0.648	2.378	0.177
17	499	0.628	1.592	0.793	1.592	0.395
16	501	0.631	1.586	0.794	1.586	0.398
20	550	0.692	1.444	0.832	1.444	0.479
14	571	0.719	1.391	0.848	1.391	0.517
12	622	0.783	1.277	0.885	1.277	0.613
13	658	0.828	1.207	0.910	1.207	0.686
28	682	0.859	1.165	0.927	1.165	0.737
25	692	0.871	1.148	0.933	1.148	0.759
19	698	0.879	1.138	0.937	1.138	0.772
24	704	0.886	1.128	0.941	1.128	0.785
4	720	0.906	1.103	0.952	1.103	0.822
6	771	0.971	1.030	0.985	1.030	0.942
3	775	0.976	1.025	0.988	1.025	0.952
5	835	1.051	0.951	1.025	0.951	1.105
27	843	1.061	0.942	1.030	0.942	1.126
9	878	1.105	0.905	1.051	0.905	1.222
15	921	1.159	0.863	1.077	0.863	1.344
18	999	1.258	0.795	1.121	0.795	1.581
22	1,061	1.336	0.749	1.156	0.749	1.784
8	1,106	1.392	0.718	1.180	0.718	1.938
1	1,115	1.404	0.713	1.185	0.713	1.970
30	1,164	1.465	0.683	1.211	0.683	2.147
2	1,583	1.993	0.502	1.412	0.502	3.971
21	1,663	2.093	0.478	1.447	0.478	4.382
11	2,191	2.758	0.363	1.661	0.363	7.607
	Average (μ)		$A_\varepsilon = 1 - \left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\mu}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}}$		$I_\theta = \left(\frac{1}{\theta(\theta-1)}\right)\left[\frac{1}{N}\sum_{i=1}^{N}\left(\frac{y_i}{\mu}\right)^{\theta} - 1\right]$	
	794		0.3876	0.0813	0.3165	0.1574

For the case of the I index, the larger the value of θ, the greater the sensitivity of the index to dispersion at the top end of the distribution. This can be appreciated by comparing the contributions to the formula given in columns (6) and (7). Larger positive values for θ correspond to greater sensitivity to high income values; increasingly negative values give greater sensitivity to low incomes. The index can be oversensitive to outliers in household income surveys, especially when $\theta \geq 2$. If $\theta \leq -1$, the index is sensitive to a few very small incomes. In these cases, it is worth checking the sensitivity of the measure by sample trimming at the top and bottom of the distribution. For $\theta = 0$ (mean log deviation), the index is particularly sensitive to changes in the middle of the distribution, very like the Gini and the Schuz coefficients. For specific values of θ, the index collapses to some well-known special cases: I_2 is half the coefficient of variation squared; I_1 is the Theil index (Theil 1967) and I_0 is the mean log deviation.

In fact, for every member of the A_ε family, there is an *ordinally equivalent* member of the *GE* class, $I_{1-\varepsilon}$ — that is, A_ε has the same ranking of distributions as $I_{1-\varepsilon}$. This simply means that if an Atkinson index A_ε indicates that there is more inequality in a distribution *B* than in a distribution *C*, then the index I_θ with $\theta = 1 - \varepsilon$ will also necessarily indicate more inequality in *B* than in *C*. Both indices satisfy the key axioms we set out as desirable for measuring inequality: symmetry, mean independence, population independence, and transfer.

Decomposing Indices

The I index has one major advantage: it is *additively decomposable* into subgroups.[76] This is a useful property because it allows us to decompose the aggregate index into within- and between-group contributions and this may help identify the underlying factors behind income inequality. If an index has this property, we can write

- Total inequality = weighted sum of inequalities *within* each subgroup plus inequality *between* groups:

$$I = I_{Within} + I_{Between}$$

where

$$I_{Within} = \sum_k w_k I_k \text{ for subgroups } k = 1, \ldots K$$

$$I_{Between} = I(\mu_1, \mu_2, \ldots, \mu_k)$$

I_k and w_k are, respectively, the inequality index and weight for subgroup k. We explain the subgroup weights below.

We split the population into K non-overlapping and exhaustive subgroups indexed by $k = 1, 2, \ldots, K$. For example, we could split the HIS sample into urban and rural households, or households by ethnicity. The index I_θ can be decomposed as

$$I_\theta = \sum_{k=1}^{K} \Phi_k \left(\frac{\mu_k}{\mu}\right)^\theta I_{\theta,k} + I_\theta\,(\mu_1, \mu_2, \mu_3, \ldots \mu_K)$$

[76] See Cowell (1980), Bourguignon (1979), and Shorrocks (1980).

where $I_{\theta,k}$ is the *I* index for subgroup *k*, Φ_k is its population share, μ_k is its mean income, and $I_\theta(\mu_1,\mu_2,\mu_3,\ldots\mu_K)$ is the *I* index over subgroup means. The first term on the right-hand side is the 'within-group' contribution and the second is the 'between - group' contribution. When $\theta =$ 0, the ratio of means term becomes unity and the weights are simply the population shares, Φ_k which necessarily sum to unity. For $\theta = 1$, the weights are the income shares of the subgroups and they also sum to unity. For other cases, the weights do not sum to one across *K*.

The decomposition of the Atkinson index is less intuitive and it is *not* additive as it is in the *GE* case, but *multiplicative*. We show in the Appendix below that the overall index can be written as

$$A_\varepsilon = A_\varepsilon^W + A_\varepsilon^B - A_\varepsilon^W \cdot A_\varepsilon^B$$

where A_ε^W and A_ε^B are the within and between values of the index. The decomposability of the Atkinson index is not as intuitively appealing as that of the *I* indices, but we can use it to get some impression of the important determinants of inequality. So to summarize, the Generalized Entropy index is additively decomposable, the Atkinson index is decomposable multiplicatively, and the Gini coefficient is not decomposable in any sense.

Sen Index

The *I* indices are particularly arbitrary in nature and not very intuitive as the following quote from Sen (1997) emphasizes: '… the fact remains that [the Theil index] is an arbitrary formula, and the average of the logarithms of the reciprocals of income shares weighted by income is not a measure that is exactly overflowing with intuitive sense.' Sen himself suggested the following index:

$$S = \mu \cdot (1 - Gini)$$

Sen (1976a) wished, as Graaf (1957) put it, 'to dispense with the time-honoured device of drawing a distinction between the size and the distribution of the national income and saying that welfare depends upon them both'. His proposed measure does just that. It is a measure of economic welfare: a higher value indicates that society is better off. The index improves (rises) either if the mean income rises with no change in the Gini or if the Gini falls with no change in the mean.

Overall Income Inequality in Malaysia, 1995–2004

Table 5.5 shows the national indices of inequality for the period 1995–2004. Two broad features are apparent: first, the measures of inequality in 2004 take very similar values to those of 1995, with the exception of the *I* index when $\theta = 2$. Given this value for θ, the *I* index is particularly sensitive to changes at the top end of the distribution, so its rise to 1.2 in 2004 suggests a possible stretching of the upper tail in the distribution for that year. However, as we noted above, the index is particularly sensitive to a few outliers at the top of the distribution. In the row labelled 'Trimmed', we report the *I* index for $\theta = 2$ in a sample in which we have removed the richest household from the dataset analysed. In the year 2004 this has a particularly pronounced effect on the index.[77] *I* indices for $\theta < 2$ all suggest a mild reduction

[77] The trimming had little effect on the indices for cases where $\theta < 2$. For example, even in 2004 when the richest household in the HIS sample was very much an extreme outlier, the index for the case where $\theta = 1$ was 0.403 for the full sample and 0.381 for the trimmed sample.

in inequality in 2004 over 1995. The Atkinson index shows little change in 2004 over 1995, whatever the value of the aversion to inequality parameter (ε).

A second striking feature of Table 5.5 is the fall in inequality indices in 1999, the year when the Asian crisis effects were evident in the survey data. This is true for all values of θ and ε. This suggests that the poorer households gained *relatively* to the richer ones in the immediate post-crisis period. This feature reflects the change in the *p90/p10* ratio reported in Table 5.3: it fell from 8.56 in 1997 to 7.87 in 1999, returning to a ratio well above 8 in the early years of the new millennium.

Given the relative constancy of the Gini coefficient, the Sen index rises in line with mean income.

TABLE 5.5 **Inequality Indices: Malaysia, 1995–2004**

	1995	1997	1999	2002	2004
Atkinson Index					
$\varepsilon = 0.5$	0.180	0.184	0.165	0.176	0.172
$\varepsilon = 1$	0.316	0.322	0.295	0.311	0.305
$\varepsilon = 2$	0.508	0.516	0.483	0.504	0.496
y_ε					
$\varepsilon = 0.5$	470.3	652.0	674.5	855.9	936.5
$\varepsilon = 1$	392.2	541.6	569.7	715.8	786.5
$\varepsilon = 2$	281.8	386.4	417.6	515.4	570.3
Mean Income	573.1	798.5	808.1	1038.6	1131.3
Median Income	378.0	524.2	552.8	702.0	769.5
Generalized Entropy					
$\theta = -1$	0.517	0.533	0.468	0.508	0.492
$\theta = 0$	0.379	0.388	0.350	0.372	0.364
$\theta = 1$	0.414	0.427	0.376	0.408	0.403
$\theta = 2$	0.739	0.810	0.643	0.825	1.249
Trimmed: $\theta = 2$	0.726	0.780	0.632	0.779	0.651
Sen Index	**464.3**	**567.8**	**512.0**	**586.6**	**613.2**

Note: y_ε : The equally distributed equivalent income is the hypothetical income which, if earned by every household, would give the same level of 'social welfare' as the actual distribution. See the Appendix below.

Inequality by Subgroups

This section analyses within- and between-subgroup decompositions. Whichever decomposition we consider, we would expect the within-group contribution to be quantitatively the most important as there will always be substantial heterogeneity across households even when they share common characteristics. Bearing this in mind, we begin with the simplest: a decomposition of inequality by stratum (urban–rural) and we present the results for all years in Table 5.6. The

TABLE 5.6 **Inequality Decomposition by Stratum: Malaysia, 1995–2004**

		1995	1997	1999	2002	2004
Atkinson Index						
$\varepsilon = 0.5$	Within Group	0.156	0.159	0.144	0.150	0.149
	Between Group	0.027	0.029	0.025	0.030	0.027
	Total	0.180	0.184	0.165	0.176	0.172
$\varepsilon = 1$	Within Group	0.277	0.281	0.259	0.267	0.266
	Between Group	0.054	0.057	0.049	0.060	0.053
	Total	0.316	0.322	0.295	0.311	0.305
$\varepsilon = 2$	Within Group	0.454	0.460	0.431	0.443	0.443
	Between Group	0.099	0.105	0.092	0.109	0.094
	Total	0.508	0.516	0.483	0.504	0.496
Generalized Entropy						
$\theta = -1$	Within Group	0.455	0.467	0.413	0.425	0.420
	Between Group	0.062	0.066	0.054	0.082	0.072
	Total	0.517	0.533	0.468	0.508	0.492
$\theta = 0$	Within Group	0.322	0.327	0.299	0.303	0.302
	Between Group	0.057	0.061	0.051	0.069	0.062
	Total	0.379	0.388	0.350	0.372	0.364
$\theta = 1$	Within Group	0.361	0.369	0.327	0.347	0.348
	Between Group	0.054	0.058	0.049	0.060	0.055
	Total	0.414	0.427	0.376	0.408	0.403
$\theta = 2$	Within Group	0.687	0.754	0.596	0.771	1.199
	Between Group	0.052	0.056	0.047	0.054	0.050
	Total	**0.739**	**0.810**	**0.643**	**0.825**	**1.249**

table helps us answer a simple question: is inequality in Malaysia largely due to urban–rural differences in income or is it largely due to intra-stratum variations in income (i.e. variations in income amongst rural and urban households)? The various measures of inequality all give the same answer: within-group contributions are substantially greater than those between groups. By way of example, the 2004 / index for $\theta = 0$ (where the subgroup weights sum to one) is 0.3636. Of this, 17 per cent is due to differential means of urban and rural incomes (the between-group contribution) and 83 per cent is due to income differences *within* urban and rural communities (the within-group contribution). These numbers are typical of the contributions for other values for θ and for the various Atkinson indices.

The decompositions by state for the year 2004 are presented in Table 5.7. The Gini coefficient (which is *not* decomposable) is given in the final column and the highest inequalities are registered for Sabah (over 0.5), Terengganu (4.6), and Kuala Lumpur and Labuan (both around

TABLE 5.7 **Inequality by State: Malaysia, 2004**

State	Generalized Entropy (I)			Atkinson (A)			Gini
	$\theta = -1$	$\theta = 0$	$\theta = 1$	$\varepsilon = 0.5$	$\varepsilon = 1$	$\varepsilon = 2$	
Johor	0.339	0.274	0.293	0.132	0.240	0.404	0.404
Kedah	0.315	0.256	0.265	0.122	0.226	0.386	0.392
Kelantan	0.325	0.286	0.326	0.142	0.249	0.394	0.419
Melaka	0.247	0.204	0.208	0.098	0.184	0.330	0.348
N. Sembilan	0.261	0.215	0.218	0.103	0.193	0.343	0.360
Pahang	0.328	0.274	0.307	0.134	0.239	0.396	0.404
P. Pinang	0.272	0.244	0.287	0.123	0.217	0.352	0.385
Perak	0.325	0.256	0.261	0.121	0.226	0.394	0.388
Perlis	0.355	0.294	0.333	0.144	0.255	0.415	0.420
Selangor	0.403	0.309	0.326	0.147	0.266	0.446	0.426
Terengganu	0.438	0.361	0.425	0.178	0.303	0.467	0.465
Sabah	0.611	0.438	0.458	0.202	0.354	0.550	0.501
Sarawak	0.396	0.326	0.368	0.159	0.278	0.442	0.442
WP KL	0.447	0.361	0.526	0.186	0.303	0.472	0.455
WP Labuan	0.429	0.349	0.396	0.170	0.295	0.462	0.457
Within-Group	0.426	0.300	0.340	0.146	0.260	0.427	
Between-Group	0.066	0.064	0.064	0.031	0.061	0.120	
Total	**0.492**	**0.364**	**0.403**	**0.172**	**0.305**	**0.496**	**0.458**

[78] Recall that the Atkinson index for ε has exactly the same ranking as the *GE* for 1-ε.

0.45). The most egalitarian states are Melaka (0.35) and Negeri Sembilan (0.36). A similar ranking applies to other measures.[78] Our main aim here is to measure the between- and within-state decompositions, given at the bottom of the table. Variations between states are dwarfed by variations within states. The 2004 / index for $\theta = 0$ is 0.3636. Of this, 0.0635 (17.5 per cent) is the between-state contribution and 82.5 per cent is the within-group contribution. State plays an important role but fails to explain a very substantial amount of income inequality.

There is also ethnic dimension to income inequality. Indeed, reducing ethic and urban–rural income inequalities are central components of policies set out in the 9MP. We report the results of decomposing the indices by ethnicity (for 1995 and 2004) in Table 5.8. We first note that amongst the three main ethnic groups, the Gini coefficient in 2004 was lowest amongst the Chinese and highest amongst the Bumiputera. The Gini suggests less inequality amongst the Chinese in 2004 compared with 1995 and more inequality amongst the Indians, with

TABLE 5.8 **Inequality by Ethnicity: Malaysia, 1995 and 2004**

Ethnic Group	Generalized Entropy $\theta = -1$	$\theta = 0$	$\theta = 1$	Atkinson $\varepsilon = 0.5$	$\varepsilon = 1$	$\varepsilon = 2$	Gini
1995							
Bumiputera	0.456	0.345	0.376	0.164	0.292	0.477	0.448
Chinese	0.396	0.323	0.363	0.157	0.276	0.442	0.440
Indian	0.351	0.296	0.331	0.145	0.256	0.412	0.423
Other	0.348	0.307	0.377	0.156	0.265	0.410	0.430
Within-Group	0.426	0.300	0.340	0.160	0.282	0.456	
Between-Group	0.066	0.064	0.064	0.024	0.047	0.097	
Total	0.517	0.379	0.414	0.180	0.316	0.508	0.468
2004							
Bumiputera	0.450	0.343	0.370	0.163	0.290	0.474	0.447
Chinese	0.382	0.310	0.374	0.153	0.266	0.433	0.427
Indian	0.394	0.312	0.338	0.150	0.268	0.441	0.431
Other	0.446	0.366	0.463	0.183	0.307	0.471	0.464
Within-Group	0.460	0.331	0.369	0.158	0.279	0.455	
Between-Group	0.032	0.033	0.034	0.017	0.036	0.076	
Total	**0.492**	**0.364**	**0.403**	**0.172**	**0.305**	**0.496**	**0.458**

TABLE 5.9 Inequality Decompositions: Malaysia, 2004

Variable	Generalized Entropy $\theta = -1$	Generalized Entropy $\theta = 0$	Generalized Entropy $\theta = 1$	Atkinson $\varepsilon = 0.5$	Atkinson $\varepsilon = 1$	Atkinson $\varepsilon = 2$
Age of HH Head						
Within-Group	0.481	0.353	0.394	0.168	0.298	0.487
Between-Group	0.011	0.010	0.010	0.005	0.010	0.018
Total	0.492	0.364	0.403	0.172	0.305	0.496
Household Size						
Within-Group	0.457	0.331	0.370	0.159	0.283	0.465
Between-Group	0.035	0.033	0.033	0.016	0.030	0.059
Total	0.492	0.364	0.403	0.172	0.305	0.496
Education of HH head						
Within-Group	0.390	0.258	0.287	0.126	0.229	0.398
Between-Group	0.102	0.105	0.116	0.054	0.099	0.163
Total	0.492	0.364	0.403	0.172	0.305	0.496
State and Education						
Within-Group	0.335	0.218	0.251	0.110	0.200	0.347
Between-Group	0.157	0.145	0.153	0.070	0.132	0.228
Total	0.492	0.364	0.403	0.172	0.305	0.496

inequality within Bumiputera communities roughly unchanged. Using the *I* index for $\theta = 0$ as an example, the within-group contribution in 2004 was 91 per cent with a between-group contribution of only 9 per cent. The latter is far lower than its level in 1995, which was 17 per cent (0.0635 as a percentage of 0.3794). Ethnicity is a minor and declining dimension of income inequality in Malaysia.

Table 5.9 reports further decompositions. Life-cycle considerations would lead one to expect the age of the head of the household to have an important effect on its income and hence our measures of inequality. However, age plays a minor role, the between-group contribution being just below 3 per cent (using the *I* index for $\theta = 0$). One might also expect household size to be important as our income measure is household income per adult equivalent and this would clearly be lowered by the presence of young members not contributing to income. Table 5.9 suggests this is not the case, with a between-group contribution of 8.7 per cent (*I* index, $\theta = 0$).

Education is known to be an important determinant of earnings and in the next decomposition, we distinguish households by the educational experience of the head of household. The between-group contribution was just below 30 per cent, suggesting that education plays a very important role in explaining income inequality in Malaysia.

In a final decomposition, we classify households by state and education and present the results in the final rows of Table 5.9. The between-group contribution is 40 per cent (again for the *I* index with $\theta = 0$). Accounting for these two characteristics of the household—its education and state—explains a very substantial proportion of Malaysian income inequality. Of course, this analysis does not reveal the factors responsible for the importance of state in this decomposition.

Concluding Comments

This chapter has examined income distribution in Malaysia using the HIS for 1995, 1997, 1999, 2002, and 2004. This is an interesting period for two reasons. First, it covered a period of substantial structural change and economic growth based on outward-looking economic and commercial policies. Secondly, in the middle of the period, Malaysia's growth was temporarily halted by the effects of the 1997 Asian crisis. The effects of the crisis were felt in the years following 1997, and they are evident in the incomes reported in the 1999 HIS.

Summing the area between the Lorenz curves and the line of equality, the Gini coefficient has been roughly constant, falling a little in the recession year, 1999, and in 2004. The other indices covered in this chapter (Robin Hood, Atkinson, and Generalized Entropy) all tell the same story. Income distribution has changed little over the period, a conclusion unaffected by calibrating our measures to give emphasis to incomes at either tail of the distribution. Economic growth in Malaysia has shifted the distribution of incomes to the right. As a result, absolute poverty has declined (Chapter 4). The constancy of relative poverty observed in Chapter 4 can be explained by the lessons of this chapter: mean incomes have risen but changes to the distribution of income around the mean have been of second order. The Asian crisis seems to have lowered inequality: richer households seem to have been disproportionately affected by the Asian crisis. Adverse short-run macroeconomic shocks have had a greater impact on measures of income inequality in Malaysia than its longer-run favourable growth performance.

APPENDIX
Derivation of the Atkinson Index

The Atkinson Index is based on a *social welfare function* defined as

$$W = \frac{1}{N}\sum_{i=1}^{N} U\,(y_i)$$

where W is social welfare and $U(y_i)$ is the 'utility' of individual i who earns y_i. W thus measures society's welfare as a whole. Suppose U has constant elasticity (ε) with respect to income; then W takes the form

$$W = \frac{1}{N}\sum_{i=1}^{N}\left[\frac{{y_i}^{1-\varepsilon}}{1-\varepsilon}\right] \varepsilon \geq 0, \varepsilon \neq 1$$

$$W = \frac{1}{N}\sum_{i=1}^{N} \log(y_i) \quad \varepsilon = 1$$

The *equally distributed equivalent income* $y\varepsilon$ is the hypothetical income which, if earned by every household, would give the same level of social welfare (W) as the *actual* distribution. Its subscript indicates that it will vary with ε because ε determines the effect income has on utility. Thus y_ε is defined as the value $\tilde{y}$ in the following:

$$\frac{1}{N}\sum_{i=1}^{N} U(y_i) = \frac{1}{N}\sum_{i=1}^{N} U(\tilde{y}) = U(\tilde{y})$$

Given the nature of the utility function (notably diminishing marginal utility), y_ε will always be less than the mean (μ) except when ε is zero. Atkinson's index is defined as the 'proportional cost of inequality' defined by

$$A_\varepsilon = 1 - \frac{y_\varepsilon}{\mu}$$

As ε rises, y_ε falls further below the mean and A_ε rises towards 1. To derive an expression for A_ε, we first solve for y_ε:

$$\frac{1}{N}\sum_{i=1}^{N}\left[\frac{{y_i}^{1-\varepsilon}}{1-\varepsilon}\right] = U(y_\varepsilon) = \frac{{y_\varepsilon}^{1-\varepsilon}}{1-\varepsilon}$$

Solving this for y_ε ,

$$y_\varepsilon = \left[\frac{1-\varepsilon}{N} \sum_{i=1}^{N} y_i^{\,1-\varepsilon} \, \frac{1}{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}$$

$$= \left[\frac{1}{N} \sum_{i=1}^{N} y_i^{\,1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}}$$

we substitute this expression for y_ε into that for A_ε to derive the Atkinson index as

$$A_\varepsilon = 1 - \left[\frac{1}{N} \sum_{i=1}^{N} \left(\frac{y}{\mu} \right)^{1-\varepsilon} \right]^{\frac{1}{1-\varepsilon}} \quad , \varepsilon \geq 0, \varepsilon \neq 1$$

$$A_\varepsilon = 1 - \exp \left[\frac{1}{N} \sum_{i=1}^{N} \log \left(\frac{y_i}{\mu} \right) \right], \varepsilon = 1$$

Decompositions of the Index

Consider the following two expressions:

$$A_\varepsilon^W = 1 - \sum_{k=1}^{K} \Phi_k \left(\frac{y_{\varepsilon,k}}{\mu} \right)$$

$$A_\varepsilon^B = 1 - y_\varepsilon / \sum_{k=1}^{K} \Phi_k \, y_{\varepsilon,k}$$

where $y_{\varepsilon,k}$ is the equally distributed equivalent income of subgroup k. A_ε^W is one minus the ratio of the weighted sum of these equivalent incomes to overall mean income μ. A_ε^W defines the *within-group* contribution to the overall index. A_ε^B is one minus the ratio of overall equivalent income to the weighted sum of subgroup equivalent incomes. This identifies the between-group component. Now consider the following combination of these components:

$$(1 - A_\varepsilon^W) \cdot (1 - A_\varepsilon^B) = \sum_{k=1}^{K} \Phi_k \left(\frac{y_{\varepsilon,k}}{\mu} \right) \times y_\varepsilon / \sum_{k=1}^{K} \Phi_k \, y_{\varepsilon,k} = \frac{y_\varepsilon}{\mu} = (1 - A_\varepsilon)$$

Thus the Atkinson index has the following *multiplicative* form:

$$1 - A_\varepsilon = (1 - A_\varepsilon^W) \cdot (1 - A_\varepsilon^B) \quad \text{or equivalently} \quad A_\varepsilon = A_\varepsilon^W + A_\varepsilon^B - A_\varepsilon^W \cdot A_\varepsilon^B$$

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