

XI. MAKING PROJECTIONS OF HOUSEHOLD CONSUMPTION AND SAVINGS USING LINEAR EXPENDITURE SYSTEMS

A. Introduction

This chapter describes a technique for making projections of household consumption and savings at the national or urban-rural level employing either of two alternative linear expenditure systems.⁴ One system is the linear expenditure system (Stone, 1954), which will be referred to as LES. The other is the extended linear expenditure system (Lluch and others, 1977), which will be referred to as ELES. These two demand systems are briefly described in annexes I and II.

Both LES and ELES postulate that household spending decisions are made on a per capita basis. In particular, LES assumes that decisions relating to the allocation of household resources available for consumption among different commodities is a function of the per capita household total expenditure and commodity prices faced by the household. ELES postulates that household decisions relating to the allocation of total household resources among alternative commodities, as well as household savings, depends on per capita disposable household income and commodity prices.

This chapter will describe variants of LES and ELES which are based on the assumption of fixed commodity prices. They can be used in preparing projections of household consumption and savings in situations where relative prices (box 21) remain unchanged. As indicated in annexes I and II, LES and ELES, under the assumption of fixed prices, are special formulations of the demand systems, which in their general form allow for the effects of both household resources and commodity prices in determining the consumption and savings behaviour of the household.

Like the demand systems described earlier (chap. X), the LES and ELES demand systems differ from each other in the way they treat household savings. In LES, total household expenditure is exogenous and so are household savings. Therefore, when LES is used to project household consumption and savings, the inputs must include assumptions on the average savings ratio. In ELES, total household expenditure and household savings are both endogenous (although the sum of expenditure and savings is exogenous). Thus, if a projection is made using ELES, household savings are obtained in the course of the projection.

Box 21

Glossary

General equilibrium model

A type of quantitative economic model that considers an economic system as a whole and involves the simultaneous determination of all prices and quantities of all goods and services in the system.

Proxy (variable)

A variable used in regression analysis to represent a theoretically more satisfactory variable in cases where either data are not available on the latter or the latter is unobservable (e. g., "desired" level of consumption).

Relative price

A price of a commodity expressed in terms of the quantity of some other commodity that has to be given up. Thus, if all prices were to increase at the same rate, absolute prices would rise but relative prices would remain unchanged.

The assumption of fixed relative prices is useful in many planning contexts. Because assumptions on changes in relative prices over time are normally very speculative, in most cases, relative prices should be projected in the context of a multisectoral general equilibrium model. Therefore, projections of household consumption and/or savings are generally prepared using the assumption of fixed relative prices.^{2/}

The assumption of fixed relative prices, a seeming weakness of this method, may actually be a strength because it enables the user to prepare projections without having to make speculative assumptions on future trends in those prices. If, however, major shifts in relative prices are expected, (e.g., over longer time periods), variants of LES and ELES that assume variable prices are recommended.

Another reason for exercising caution in preparing long-term projections with this method is that for certain commodity groups there might be a systematic relationship (positive or negative) between the size of the coefficients of LES or ELES expenditure functions, on the one hand, and the level of per capita total household expenditure or per capita disposable household income, on the other (Lluch and others, 1977). Therefore, if major increases in per capita household

expenditure or per capita disposable income are anticipated over the long run, it may be prudent to restrict projections to the medium run in order to avoid biases in projections that could otherwise result from the fact that a fixed set of partial coefficients of the expenditure functions are used over the entire projection period.

A variety of factors, other than income and prices, may have an important influence on consumer behaviour. Among such factors are the size and composition of households, age of the household head, location of residence and socio-economic class (or group) of household. In spite of the potential significance of each of those factors, this method explicitly takes into account only the effect of the location of residence. The differences among urban and rural consumption and savings patterns can be explicitly taken into account by preparing separate projections for urban and rural locations. The influence of the other factors cannot be taken into account explicitly owing to the fact that expenditure functions of LES and ELES do not include measures of those factors or their proxies as explanatory variables.

Unlike the functions described in chapter X, which can have linear or non-linear specifications, the functions of the LES and ELES demand systems must be linear. As a result, those functions possess the adding-up property, which ensures that the projected levels of per capita consumption for each commodity group will add up to the level of per capita total expenditures.

The LES and ELES expenditure functions can be estimated using time series or cross-section data. However, owing to the limited availability of time series information in many developing countries, planners in those countries may have no choice but to use cross-section data. This may be an advantage or a disadvantage, depending on whether or not one wishes to make the assumption of constant relative prices.

B. The technique

This section will describe in general terms the technique for projecting consumption using the LES demand system and consumption and savings using the ELES demand system. After presenting an overview, the technique for making a national projection will be described. Finally, the technique for making urban and rural projections will be presented.

1. Overview

This overview will enumerate the inputs required to apply the method, indicate the type of outputs that can be generated and outline the computational steps involved in preparing household consumption and savings projections. These steps are basically the same for both national level and rural-urban projections.

(a) Inputs

To project household consumption and savings, the following inputs are required:

- (i) Projected per capita disposable household income;
- (ii) Projected population size;
- (iii) Estimates of the coefficients of the expenditure functions by commodity group.

In addition, if the projection is to be based on LES, the inputs should also include:

- (iv) Assumptions on the average household savings ratio.

The inputs are listed in box 22.

If a national projection is sought, those inputs should refer to the entire country. If a projection for urban and rural areas is desired, corresponding inputs would need to be provided for urban and rural locations.

This method will be described in the context of preparing quinquennial projections. In view of this, projections of per capita disposable household income and population size for dates five years apart would be needed. In addition, if the projection is to utilize assumptions on the average savings ratio, those assumptions should refer to those same dates. Given appropriate annual inputs, however, the technique could also be used for preparing annual projections.

(b) Outputs

For national as well as urban-rural projections, the method can be used to generate the following outputs:

- (i) Levels of per capita household consumption by commodity group, and per capita household savings;
- (ii) Levels of household consumption by commodity group and household savings;
- (iii) Various household consumption and savings aggregates, such as the level of total household consumption and levels of household consumption by broad commodity group;
- (iv) Indicators of the spending pattern of households, such as proportions of total disposable household income spent on commodities of different groups or saved;
- (v) Rates of change of household consumption or savings, including that of total household consumption and savings.

Box 22

Inputs for preparing projections of household consumption
and savings using the linear expenditure system
or the extended linear expenditure system

1. Per capita disposable household income (national or urban and rural)
2. Population size (national or urban and rural)
3. Estimates of expenditure functions (national or urban and rural)

either

Coefficients of expenditure functions of the linear expenditure system

or

Coefficients of expenditure functions of the extended linear expenditure system

4. Assumptions on the average household savings ratio (national or urban and rural; if the linear expenditure system is used)

If the technique is used to prepare projections for urban and rural areas, the results would include all those listed under (i) through (v), for urban and rural areas separately as well as for the entire country. In addition, they would include indicators of the urban-rural distribution of household consumption and savings. The types of outputs that can be produced with this method are presented in box 23.

(c) Computational steps

For any given projection date, the first step in making the projection is to calculate levels of per capita household consumption by commodity group and per capita household savings. If household savings are exogenous, those levels are obtained for a particular date as follows: first, the level of per capita total household expenditure is obtained as a product of the per capita disposable household income and the complement of the assumed average savings ratio for that date; secondly, the levels of household consumption by commodity group are

Box 23

Types of outputs derived from projections of household consumption and savings using the linear expenditure system or the extended linear expenditure system

1. Levels of per capita household consumption by commodity group and per capita household savings (national or urban, rural and national)
2. Levels of household consumption by commodity group and household savings (national or urban, rural and national)
3. Household consumption and savings aggregates (national or urban, rural and national)

Levels of total household consumption, household consumption by broad commodity group and household savings

Growth in total household consumption, household consumption by broad commodity group and household savings

4. Indicators of the spending pattern of households (national or urban, rural and national)

Proportions of disposable household income spent on goods and services in broad commodity groups or saved

5. Indicators of the urban-rural distribution of total household consumption and savings (national only, if urban and rural household consumption and savings are being projected)

Proportions of total household consumption and savings in different locations

6. Rates of growth of household consumption and savings (national or urban, rural and national)

Rates of growth in total household consumption, household consumption by broad commodity groups and household savings

obtained by evaluating the LES expenditure functions using the per capita total expenditure obtained for that date. Finally, projected per capita savings are calculated as the difference between per capita disposable household income and per capita total household expenditure.

If household savings are endogenous, those results are obtained as follows. First, the levels of per capita household consumption by commodity group are obtained by evaluating the ELES expenditure functions using the projected level of per capita disposable household income. Projected per capita savings are obtained as the difference between per capita disposable household income and the sum of the projected levels of per capita consumption for different commodity groups.

This method can be used to calculate other results, including levels of household consumption by commodity group and the level of total household savings. Those levels can be obtained by multiplying the projected population size by the levels of per capita household consumption (disaggregated by commodity group) and per capita household savings, respectively. The method also includes steps to obtain various aggregates, such as the level of total household consumption, indicators of the spending pattern of households and rates of increase of various household consumption and savings aggregates.

2. National level

This section will describe two closely related procedures for projecting household consumption and savings at the national level. It will first describe a procedure that uses the linear expenditure system, which requires assumptions on the average household savings ratio. It will then introduce a procedure that employs the extended linear expenditure system, in which household savings are endogenous.

(a) Procedure based on the linear expenditure system

This section will initially introduce expenditure functions of the linear expenditure system. Then it will describe the steps required to derive levels of per capita household consumption by commodity group and the level of per capita household savings. The section will also describe the steps needed to derive other results. A summary of those steps is shown in box 24 and some steps are indicated in figure XXII.

(i) Expenditure functions

The linear expenditure system postulates that the level of per capita household consumption for each commodity group is a linear function of the level of per capita total household expenditure. Therefore, this system consists of the following functions:

$$PCC(g,t') = a(g) + b(g) \cdot PCTHE(t'); \quad (1)$$

$$g = 1, \dots, G,$$

Box 24

Computational steps to project household consumption and savings at the national level using the linear expenditure system

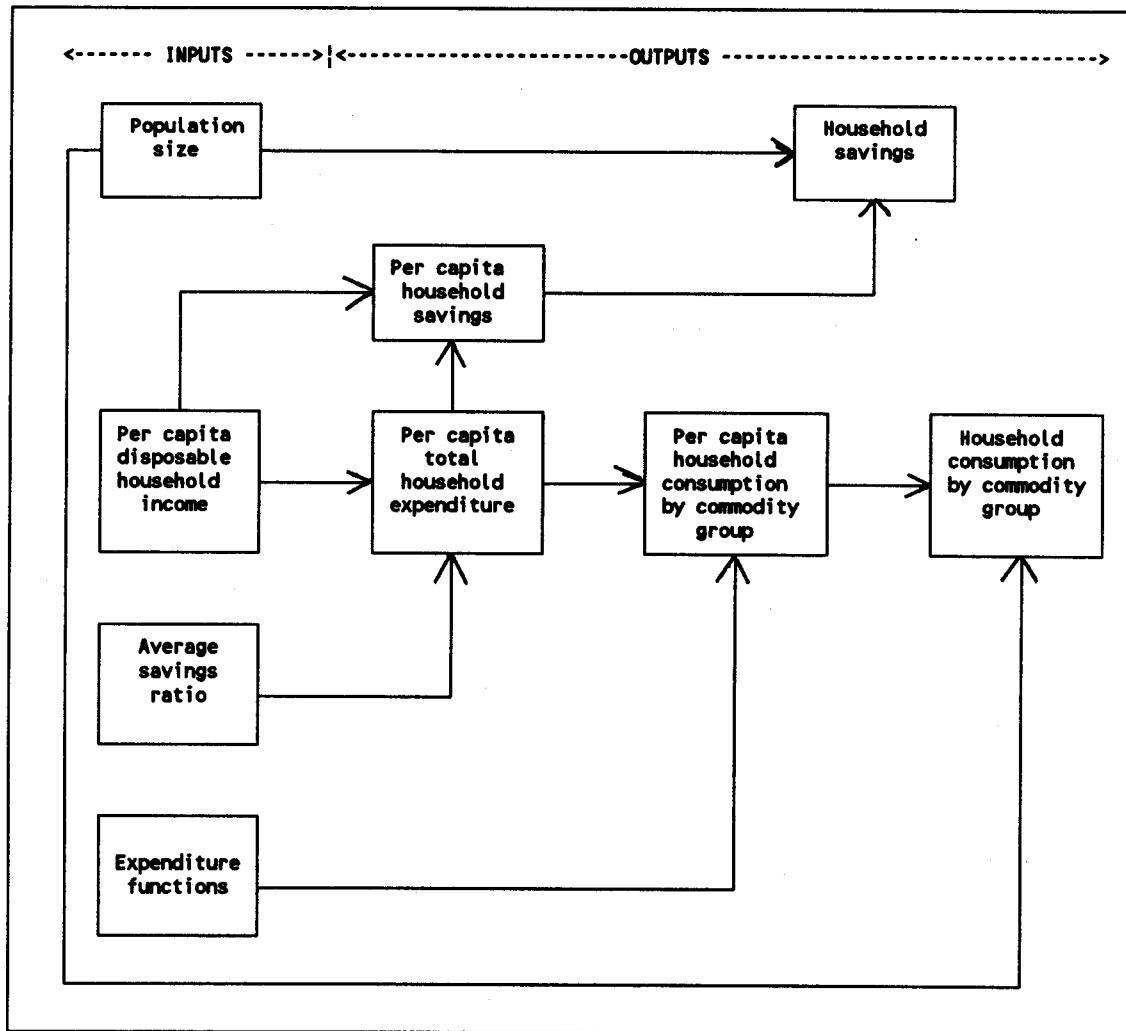
The steps used to project household consumption and savings at the national level over a five-year projection interval with the linear expenditure system are as follows:

1. For the end of the projection interval, compute per capita total household expenditure as a product of per capita disposable household income and the complement of the average household savings ratio.
2. Derive projected levels of per capita household consumption by commodity group at the end of the interval by evaluating empirically estimated expenditure functions using the projected level of per capita total household expenditure.
3. Derive the level of per capita household savings as the difference between the per capita disposable household income and the per capita total expenditure obtained in step 1.
4. Calculate levels of household consumption for each commodity group and the level of household savings as the product of the population size multiplied by the levels of per capita household consumption obtained in step 2 and the level of per capita household savings derived in step 3, respectively.
5. Calculate various household consumption and savings aggregates, such as total household consumption and the increase in total household consumption.
6. Derive indicators of the spending pattern of households, such as the proportions of household disposable income spent on various goods and services or saved.
7. Obtain rates of growth of household consumption and savings.

where:

- | | |
|-------------------|------------------------------------|
| $g = 1, \dots, G$ | are commodity groups, |
| G | is the number of commodity groups, |
| t' | is the calendar year, |

Figure XXII. Steps to project household consumption and savings at the national level using linear expenditure system



- PCC(g,t') is the level of per capita consumption of goods and services in commodity group g in year t',
- PCTHE(t') is the level of per capita total household expenditure in year t',
- a(g) is the intercept coefficient of the expenditure function for commodity group g in the linear expenditure system, and
- b(g) is the partial coefficient of per capita total household expenditure in the expenditure function for commodity group g in the linear expenditure system.

The partial coefficients in the expenditure functions shown in equation (1), b(g)'s, are marginal budget shares or marginal propensities to consume out of total expenditure. The sum of those coefficients over all commodity groups equals one.

(ii) Levels of per capita household consumption and savings

To obtain the levels of per capita household consumption by commodity group and the level of per capita household savings, it is initially necessary to calculate the level of per capita total household expenditure. This figure is used to calculate per capita consumption by commodity group and per capita savings.

a. Level of per capita total household expenditure

The level of per capita total household expenditure can be derived for a given projection date as the product of the level of per capita disposable household income and the complement of the assumed average savings ratio for that date. Thus, for (t+5), the end of the projection interval (t to t+5), the level of per capita total household expenditure is:

$$PCTHE(t+5) = PCDHI(t+5) \cdot [1 - ASVR(t+5)], \quad (2)$$

where:

- t is the base year of the projection period,
- PCTHE(t+5) is the level of per capita total household expenditure at the end of the interval,
- PCDHI(t+5) is the level of per capita disposable household income at the end of the interval, and
- ASVR(t+5) is the average household savings ratio at the end of the interval.

b. Levels of per capita household consumption by commodity group

Once the level of per capita total household expenditure has been calculated, levels of per capita household consumption by commodity group can be projected using estimates of the coefficients of the expenditure functions as follows:

$$PCC(g,t+5) = a^*(g) + b^*(g) \cdot PCTHE(t+5); \quad (3)$$

$$g = 1, \dots, G,$$

where:

$PCC(g,t+5)$ is the level of per capita household consumption of goods and services in commodity group g at the end of the interval,

$a^*(g)$ is the estimate of the intercept coefficient of the expenditure function for commodity group g in the linear expenditure system, and

$b^*(g)$ is the estimate of the partial coefficient of per capita total household expenditure in the expenditure function for commodity group g in the linear expenditure system.

c. Level of per capita household savings

After the level of per capita total household expenditure has been derived as indicated in equation (2), the level of per capita household savings can be obtained as the difference between the levels of per capita disposable income and per capita total expenditure. Thus, for the end of the projection interval (t to $t+5$):

$$PCSV(t+5) = PCDHI(t+5) - PCTHE(t+5), \quad (4)$$

where:

$PCSV(t+5)$ is the level of per capita household savings at the end of the interval.

(iii) Levels of household consumption by commodity group and household savings

Given the projected levels of per capita household consumption in each commodity group and the level of per capita household savings, projected levels of household consumption in each commodity group and the projected level of savings can be obtained by multiplying the population size by the levels of per capita household consumption and the level of savings, respectively.

a. Household consumption by commodity group

For each commodity group, the levels of household consumption at the end of the projection interval (t to t+5) can be obtained as follows:

$$HC(g,t+5) = PCC(g,t+5) \cdot POP(t+5); \quad (5)$$

$$g = 1, \dots, G,$$

where:

HC(g,t+5) is the level of household consumption of goods and services in commodity group g at the end of the interval, and

POP(t+5) is the population size at the end of the interval.

b. Household savings

The level of household savings at the end of the projection interval can be obtained in an analogous way:

$$HSV(t+5) = PCSV(t+5) \cdot POP(t+5), \quad (6)$$

where:

HSV(t+5) is the level of household savings at the end of the interval.

(iv) Other results^{3/}

Once the levels of household consumption by commodity group and levels of household savings are projected for the end of a given interval, several derived indicators can be calculated. These indicators include various aggregates of household consumption and savings, indicators of the spending pattern of households and rates of change of household consumption and savings.

a. Household consumption and savings aggregates

The level of total household consumption is a key aggregate that can be calculated from the projected levels of household consumption by commodity group. Using the same results, it is also possible to obtain the levels of household consumption by broad commodity groups, such as food and clothing. Once the total and broad-commodity-group levels of household consumption are obtained for different dates five years apart, increases in those totals over the intervening projection intervals can be calculated. In addition, one can calculate increases in household savings for those projection intervals.

i. Total household consumption

Total household consumption can be obtained by aggregating the levels of household consumption classified by commodity group. For the end of the projection interval (t to t+5) this total can be obtained as follows:

$$HC(t+5) = \sum_{g=1}^G HC(g,t+5), \quad (7)$$

where:

$HC(t+5)$ is the level of total household consumption at the end of the interval.

ii. Household consumption by broad commodity groups

If the projection of household consumption and savings involves many narrowly defined commodity groups, projected household consumption levels disaggregated by those groups can be reaggregated into levels of consumption for a relatively small number of broader groups. The rules of aggregation used in deriving household consumption levels by broad groups may vary from one application of the method to another depending on the primary commodity groups used in the projection. In this description of the method, this aggregation will be considered in general terms, and it will be illustrated as part of the projection examples in section D.

In particular, the levels of household consumption for broad commodity groups at the end of the given projection interval (t to t+5) can be obtained as follows:

$$HC(h,t+5) = T [HC(g,t+5)]; \quad (8)$$

$$h = 1, \dots, H,$$

where:

$h = 1, \dots, H$ are broad commodity groups,

H is the number of broad commodity groups,

$HC(h,t+5)$ is the level of household consumption of goods and services in broad commodity group h at the end of the interval, and

T is a transformation indicating the way household consumption levels by commodity groups are aggregated to obtain household consumption levels by broad commodity groups.

iii. Growth in total household consumption

The growth in total household consumption over the projection interval equals the difference between the levels of total household consumption at the end and at the beginning of the interval:

$$HCG = HC(t+5) - HC(t); \quad (9)$$

where:

HCG is the growth of total household consumption during the interval.

iv. Growth of household consumption by broad commodity groups

The increases in household consumption in various broad commodity groups over the projection interval are obtained as follows:

$$HCG(h) = HC(h, t+5) - HC(h, t); \quad (10)$$

$$h = 1, \dots, H,$$

where:

HCG(h) is the growth of household consumption in broad commodity group h over the interval.

v. Growth in household savings

The growth in household savings over the projection interval equals the difference between household savings at the end and at the beginning of the interval:

$$HSVG = HSV(t+5) - HSV(t); \quad (11)$$

where:

HSVG is the growth of household savings during the interval.

b. Indicators of the spending pattern of households

Once the various household consumption aggregates are obtained, it is further possible to derive the proportions of disposable household income that are either spent on goods and services in various broad commodity groups or saved.

i. Disposable household income

To calculate those proportions, it is first necessary to obtain the level of disposable household income as the product of per capita disposable household income and population size. For the end of the projection interval, disposable household income can be obtained as follows:

$$DHI(t+5) = PCDHI(t+5) \cdot POP(t+5); \quad (12)$$

where:

DHI(t+5) is the disposable household income at the end of the interval.

ii. Proportions of disposable household income spent on goods and services in broad commodity groups

Proportions of disposable household income that are spent on goods and services in different broad commodity groups can be obtained by dividing the levels of household consumption in broad groups by the level of disposable household income. For the end of the projection interval, those proportions can be obtained as follows:

$$\text{PRDHIC}(h,t+5) = \text{HC}(h,t+5) / \text{DHI}(t+5); \quad (13)$$

$$h = 1, \dots, H,$$

where:

$\text{PRDHIC}(h,t+5)$ is the proportion of disposable household income spent on consumption of goods and services in broad commodity group h at the end of the interval.

iii. Proportion of disposable household income saved

The proportion of disposable household income saved can be obtained as the level of household savings divided by the level of disposable household income. For the end of the projection interval, this proportion is obtained as follows:

$$\text{PRDHISV}(t+5) = \text{HSV}(t+5) / \text{DHI}(t+5); \quad (14)$$

where:

$\text{PRDHISV}(t+5)$ is the proportion of disposable household income saved at the end of the interval.^{4/}

c. Rates of growth of household consumption and savings

As part of the household consumption and savings projection, it is also possible to compute average annual rates of growth of household consumption -- total and by broad commodity groups. It is also possible to compute average annual rates of growth of household savings.

i. Rate of growth of total household consumption

The average annual rate of growth of total household consumption over a given projection interval can be computed from the total household consumption at the beginning and the end of the interval.

Geometric growth rates. If it is assumed that growth in household consumption occurs over discrete intervals, then the percentage growth rate can be obtained using the formula for a geometric growth rate:

$$\text{GGRHC} = [(\text{HC}(t+5)/\text{HC}(t))^{1/5} - 1] \cdot 100; \quad (15)$$

where:

GGRHC is the average annual geometric growth rate of total household consumption for the interval.

Exponential growth rates. Alternatively, if the planner treats growth as continuous, then the percentage growth rate of total household consumption should be calculated using the formula for an exponential growth rate:

$$\text{EGRHC} = [\ln (\text{HC}(t+5)/\text{HC}(t)) / 5] \cdot 100; \quad (16)$$

where:

EGRHC is the average annual exponential growth rate of total household consumption for the interval.

ii. Rates of growth of household consumption by broad commodity groups

Geometric growth rates. If it is assumed that growth of household consumption is discrete, percentage rates of increase of household consumption by broad commodity groups can be obtained as follows:

$$\text{GGRHC}(h) = [(\text{HC}(h,t+5)/\text{HC}(h,t))^{1/5} - 1] \cdot 100; \quad (17)$$

$$h = 1, \dots, H,$$

where:

GGRHC(h) is the average annual geometric growth rate of household consumption in broad commodity group h for the interval.

Exponential growth rates. If growth is assumed to be continuous, then the percentage rates of growth of household consumption by broad groups would be calculated using the following formula:

$$\text{EGRHC}(h) = [\ln (\text{HC}(h,t+5)/\text{HC}(h,t)) / 5] \cdot 100; \quad (18)$$

$$h = 1, \dots, H,$$

where:

EGRHC(h) is the average annual exponential growth rate of household consumption in broad commodity group h for the interval.

iii. Rate of growth of household savings

Geometric growth rate. If it is assumed that growth in household savings occurs over discrete intervals, the percentage growth rate can be obtained using the formula for calculating a geometric growth rate:

$$\text{GGRHSV} = [(\text{HSV}(t+5)/\text{HSV}(t)^{1/5} - 1) \cdot 100; \quad (19)$$

where:

GGRHSV is the average annual geometric growth rate of household savings for the interval.

Exponential growth rate. Alternatively, if it is assumed that growth is continuous, then the percentage rate of growth of household savings can be calculated as follows:

$$\text{EGRHSV} = [\ln (\text{HSV}(t+5)/\text{HSV}(t)) / 5] \cdot 100; \quad (20)$$

where:

EGRHSV is the average annual exponential growth rate of household savings for the interval.

This completes the description of the procedure to project household consumption and savings at the national level using the linear expenditure system. The next section will describe the procedure to project household consumption and savings using the extended linear expenditure system.

(b) Procedure based on the extended linear expenditure system

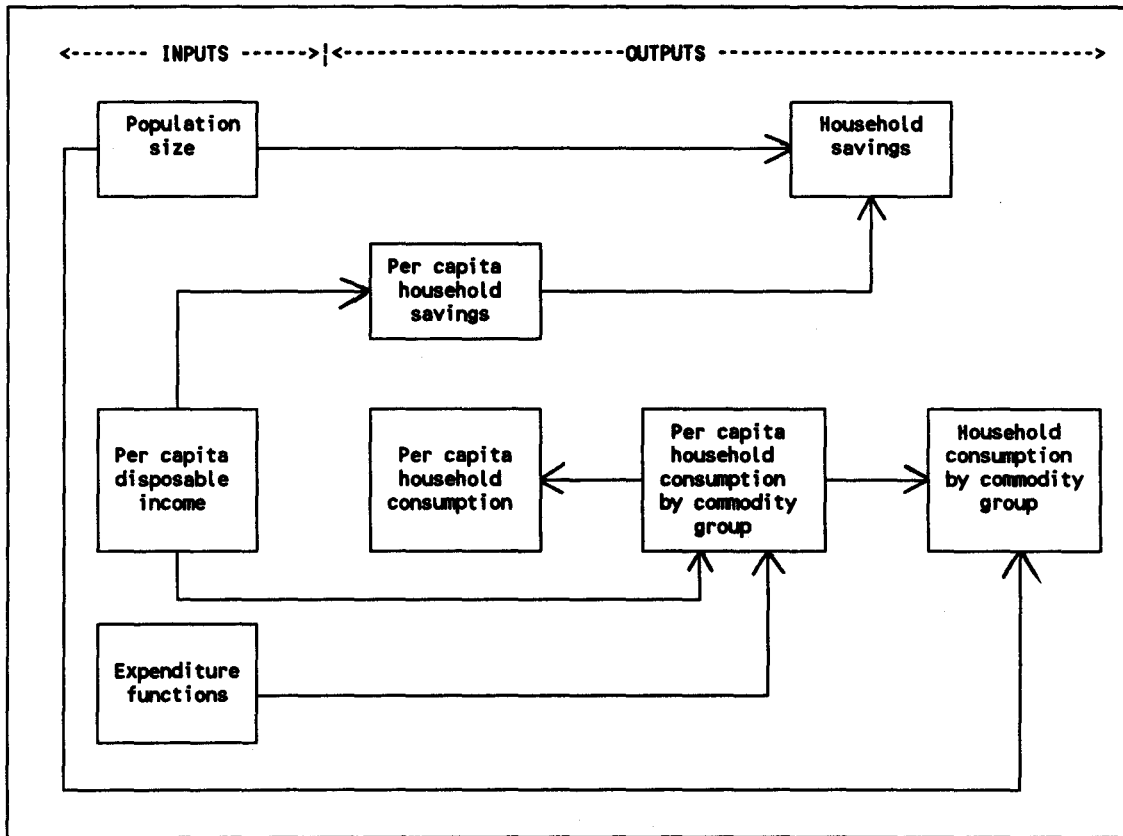
This section will initially describe expenditure functions of the extended linear expenditure system. Then it will describe the steps needed to derive levels of per capita household consumption by commodity group and the level of per capita household savings. The section will also outline the steps needed to derive other results for a given projection date or interval. A summary of those steps is shown in box 25 and some of those steps are indicated in figure XXIII.

(i) Expenditure functions

The extended linear expenditure system postulates that the level of per capita household consumption for each commodity group is a linear function of the level of per capita disposable household income. Therefore, the system consists of the following functions:

$$\begin{aligned} \text{PCC}(g,t') &= a(g) + b(g) \cdot \text{PCDHI}(t'); & (21) \\ g &= 1, \dots, G, \end{aligned}$$

Figure XXIII. Steps to project household consumption and savings at the national level using the extended linear expenditure system



where:

- PCDHI(t') is the level of per capita disposable household income in year t' ,
- $a(g)$ is the intercept coefficient of the expenditure function for commodity group g in the extended linear expenditure system, and
- $b(g)$ is the partial coefficient of per capita disposable household income in the expenditure function for commodity group g in the extended linear expenditure system.

The partial coefficients in the expenditure functions shown in equation (21), $b(g)$'s, are marginal propensities to consume out of disposable income. The sum of those coefficients equals the aggregate marginal propensity to consume. That is, this sum indicates the proportion of each additional unit of disposable income that is devoted to household consumption.

(ii) Levels of per capita household consumption and savings

In deriving levels of per capita consumption and savings, it is possible first to obtain the levels of per capita consumption by commodity group. These levels can then be aggregated to yield per capita total household consumption, which, when subtracted from per capita disposable household income, yields per capita household savings.

a. Levels of per capita household consumption by commodity group

The levels of per capita household consumption by commodity group can be projected for the end of the projection interval using estimates of the expenditure functions of the extended linear expenditure system as follows:

$$\text{PCC}(g,t+5) = a^*(g) + b^*(g) \cdot \text{PCDHI}(t+5); \quad (22)$$
$$g = 1, \dots, G,$$

where:

- $a^*(g)$ is the estimate of the intercept coefficient of the expenditure function for commodity group g in the extended linear expenditure system, and
- $b^*(g)$ is the estimate of the partial coefficient of per capita disposable household income in the expenditure function for commodity group g in the extended linear expenditure system.

b. Level of per capita total household consumption

Per capita total household consumption can be obtained as the sum of the projected levels of per capita household consumption by commodity group:

$$PCC(t+5) = \sum_{g=1}^G PCC(g,t+5); \quad (23)$$

Box 25

Computational steps to project household consumption and savings at the national level using the extended linear expenditure system

The steps used to project household consumption and savings at the national level over a five-year projection interval with the extended linear expenditure system are as follows:

1. Derive projected levels of per capita household consumption by commodity group at the end of the interval by evaluating empirically estimated expenditure functions using the projected level of per capita disposable household income for that date.
2. Derive the level of per capita household savings as the difference between the per capita disposable household income and the sum of projected levels of per capita consumption by commodity group.
3. Calculate levels of household consumption for each commodity group and the level of household savings as the product of population size multiplied by the levels of per capita household consumption derived in step 1 and household savings obtained in step 2, respectively.
4. Calculate various household consumption and savings aggregates, such as total household consumption and the increase in total household consumption.
5. Derive indicators of the spending pattern of households, such as proportions of household disposable income spent on various goods and services or saved.
6. Obtain rates of growth of household consumption and savings, such as the rate of growth of total household consumption.

where:

$PCC(t+5)$ is the level of per capita total household consumption at the end of the interval.

c. Level of per capita household savings

The level of per capita household savings can be obtained as the difference between the level of per capita disposable household income and the level of per capita total consumption. Thus, for the end of the projection interval (t to t+5):

$$PCSV(t+5) = PCDHI(t+5) - PCC(t+5); \quad (24)$$

(iii) Levels of household consumption and savings and other results

Given the projected levels of per capita household consumption and savings, the levels of household consumption by commodity group and household savings may be obtained using the steps indicated in equations (5) and (6).

Other results, which include household consumption and savings aggregates, indicators of the spending pattern of households and rates of changes of household consumption and savings, can be obtained by means of the steps indicated in equations (7) through (20).

3. Urban-rural level

The previous section dealt with projections of per capita consumption and savings at the national level. This section will discuss procedures for projecting household consumption and savings for urban and rural areas separately. It will first describe the procedure based on the linear expenditure system. Then, it will outline the procedure that uses the extended linear expenditure system.

(a) Procedure based on the linear expenditure system

The procedure for making urban and rural projections of household consumption and savings based on the linear expenditure system is an urban-rural equivalent of the procedure for preparing the national projections.

(i) Expenditure functions

The expenditure functions of the linear expenditure system used by the procedure are urban-rural equivalents of the functions shown in equation (1).

(ii) Levels of per capita household consumption and savings

The steps used by this procedure to project levels of per capita household consumption and per capita household savings for the two areas are urban-rural equivalents of the steps indicated in equations (2) through (4).

(iii) Levels of household consumption and savings

Levels of household consumption and savings for urban and rural areas can be derived from projected levels of per capita household consumption and savings for

those areas by means of calculations that are urban-rural equivalents of the steps shown in equations (5) and (6).

(iv) Other results

The various indicators discussed in connection with the national projections can also be computed as part of an urban-rural projection. Those indicators are calculated for urban and rural areas and for the entire country, using steps analogous to those indicated by equations (7) through (20). In addition, indicators of the distribution of total household consumption and total household savings by residential location -- proportions urban and rural -- can be calculated.

a. Proportions of total household consumption that are urban and rural

The proportion of total household consumption at the end of the projection interval that is urban can be computed by dividing the level of total household consumption in urban areas ($k=1$) by the level of total household consumption for the entire country:

$$\text{PRHCURB}(t+5) = \text{HC}(1,t+5) / \text{HC}(t+5); \quad (25)$$

where:

$k = 1, 2$ are urban and rural locations,
 $\text{PRHCURB}(t+5)$ is the proportion of total household consumption that is urban at the end of the interval, and
 $\text{HC}(k,t+5)$ is the total household consumption in location k at the end of the interval.

The proportion of total household consumption that is rural can be found as a complement of the proportion urban:

$$\text{PRHCRUR}(t+5) = 1 - \text{PRHCURB}(t+5); \quad (26)$$

where:

$\text{PRHCRUR}(t+5)$ is the proportion of total household consumption that is rural at the end of the interval.

b. Proportions of household savings that are urban and rural

The proportion of household savings that is urban at the end of the projection interval can be computed by dividing the level of household savings in urban areas ($k=1$) by the level of household savings for the entire country:

$$\text{PRHSVURB}(t+5) = \text{HSV}(1,t+5) / \text{HSV}(t+5); \quad (27)$$

where:

PRHSVURB(t+5) is the proportion of household savings that is urban at the end of the interval, and

HSV(k,t+5) is the level of household savings in location k at the end of the interval.

The proportion of household savings that is rural can be derived as a complement of the relevant proportion that is urban:

$$\text{PRHSVRUR}(t+5) = 1 - \text{PRHSVURB}(t+5); \quad (28)$$

where:

PRHSVRUR(t+5) is the proportion of household savings that is rural at the end of the interval.

(b) Procedure based on the extended linear expenditure system

The procedure for projecting urban and rural household consumption and savings using the extended linear expenditure system is the urban-rural counterpart of the procedure using the national-level extended linear expenditure system.

(i) Expenditure functions

The expenditure functions of this system are urban-rural equivalents of the functions shown in equation (21).

(ii) Levels of per capita household consumption and savings

The steps employed by this procedure to obtain levels of per capita consumption and savings are urban-rural counterparts of the steps shown in equations (22) through (24).

(iii) Levels of household consumption and savings and other results

To derive levels of household consumption by commodity group and household savings, as well as other results, this procedure uses steps that are identical to the corresponding steps of the procedure for making urban-rural projections with the linear expenditure system.

C. Inputs

This section will initially list the types of inputs required by the method and then describe how they can be prepared. In particular, it will show how assumptions on the average savings ratio are prepared. It will also describe how estimates of the expenditure functions of alternate demand systems are prepared and illustrate the calibration of empirically estimated functions.

1. Types of inputs required

To project household consumption and savings using one of the two per capita expenditure systems the following inputs are required:

- (i) Projected per capita disposable household income;
- (ii) Projected population size;
- (iii) Estimates of the coefficients of the expenditure function for each commodity group.

In addition, if the procedure being used is based on the linear expenditure system, the inputs must also include:

- (iv) Assumptions on the average household savings ratio.

Depending on whether one wishes to make a national projection or a projection for urban and rural areas, the inputs will be for the entire country or for urban and rural areas.

2. Preparation of inputs

To apply the method, projections of per capita disposable household income are required. These projections can be prepared by the method based on the social accounting matrix, which was described in chapter IX. Also, projections of population size are needed. These can be made using the cohort component method, as described in chapter II.

In addition, the coefficients of the expenditure functions by commodity group need to be estimated. If the projection procedure used is based on the linear expenditure system, the estimates of the coefficients need to be supplemented by assumptions on the average household savings ratio. (Such assumptions are not needed to apply the extended linear expenditure system, which treats household savings endogenously.)

In this section, the preparation of assumptions on future levels of the average household savings ratio will be considered. This will be followed by a discussion relating to the estimation of coefficients of expenditure functions and a brief discussion of techniques for the calibration of empirically estimated functions.

(a) Assumptions on the average household savings ratio

To prepare assumptions on future levels of the average household savings ratio, it is initially necessary to select the level (or levels) of This savings ratio for the base year of the projection. As a rule, this will require recent information on household income and savings. However, such information may not be included in the data set used to estimate expenditure functions of the linear expenditure system since LES would typically be used in situations where reliable information on disposable household income and savings was not available.

The household income and savings data that are needed to select the level of the average household savings ratio for a national projection may come from the national accounts or a social accounting matrix. The data required to select levels of the savings ratio for the urban-rural projection would normally come from a social accounting matrix, which includes household income and savings disaggregated by urban-rural location. Generally, the national accounts would not contain this type of information disaggregated by location.

Whichever data source is used, the average household savings ratio for a recent year can be obtained as a ratio of the level of household savings to that of disposable household income for the entire country or a given area. The savings ratio can then be used as a basis for deciding on the average savings ratio for the base year of the projection. It would be of limited value, however, for making assumptions on the savings ratio for other dates over the projection period. Those assumptions should be made by taking into account the likely future changes in per capita disposable household income, as well as changes in other factors that may have an effect on the household savings behaviour.

In making assumptions on the average savings ratio for dates 5, 10 or more years following the initial year of projection, it is important to consider projected changes in the level of per capita disposable household income over the period for which the assumptions are to be made. For example, if per capita disposable income were projected to increase over time, the assumptions on future average household savings ratios must take that into account. All other things being equal, the more rapid the projected increase in the per capita disposable household income, the more likely it is that the average savings ratio will increase over the projection period. This would be true if the income elasticity of savings were greater than unity, as is often the case in developing countries. Other factors, such as household size and changes in household composition, may have an effect on savings behaviour. For example, reduced young-age dependency in the household may increase the household's propensity to save (Mason and others, 1987a). Evidence relating to the impact of the increase in old-age dependency on household savings is less conclusive, but suggests that among certain categories of households the increase in the proportion of household members who are elderly tends to depress savings. Moreover, in certain countries, there is a clear-cut inverse-U-shaped relationship between the age of the household head and the household's propensity to save (Mason and others, 1987b). Where shifts in the household composition are considered likely, assumptions on future trends in the average household savings ratio may take their likely impact into account.

(b) Estimates of expenditure functions of alternative expenditure systems

Estimates of the coefficients of the expenditure functions of the LES and ELES systems can be prepared using standard methods of regression analysis, such as ordinary least squares (OLS). Depending on the area for which the projection is intended (national or urban-rural), the estimates of the functions would refer to the entire country or urban and rural areas separately. The estimation procedure could use time series information or cross-section data. In the majority of developing countries, however, only cross-section data would be available and, therefore, only this type of data will be considered below.

(i) Cross-section data

Cross-section data that could be used to estimate the expenditure functions of the linear expenditure system typically come from a household budget survey. Such a survey normally includes information on expenditures for various consumption goods and services, quantities of various products consumed from the household's own production, and estimates of total household expenditure. The survey data should also include, at the minimum, information on household size. This type of data would make it possible to derive observations on levels of per capita household consumption expenditures for the various groups of commodities and the level of per capita total household expenditure, which would suffice for the estimation of expenditure functions of this demand system.

To estimate expenditure functions of the extended linear expenditure system, the requisite data should come from a household income and expenditure survey. Besides information collected in a typical household budget survey, the household income and expenditure survey should include data on disposable household income. Information collected in such a survey would provide a sufficient basis for deriving observations on the level of per capita household consumption for the various commodity groups and the level of per capita disposable household income; such observations would be required to estimate functions of this demand system. Box 19 in chapter X discusses in greater detail the data needed in estimating the two demand systems and outlines their preparation for analysis.

If the income data collected in a household income and expenditure survey are inadequate or unreliable, it would not be warranted to use the extended linear expenditure system for projecting consumption and savings. In such an instance, it would be better to use those data to estimate the linear expenditure system, that is, expenditure functions with per capita total household expenditure as the explanatory variable.

(ii) Procedures to estimate alternative expenditure systems

This section will first describe procedures used to estimate the coefficients of the LES and ELES demand systems at the national level and then describe procedures for estimating the coefficients of those systems at the urban-rural level.

a. National level

In describing estimation procedures applicable at the national level, those used to estimate expenditure functions of the linear expenditure system will be presented first.

1. Linear expenditure system

To estimate the coefficients of expenditure functions of the linear expenditure system, it is necessary to rewrite the functions shown in equation (1) and to add a random disturbance term to each to obtain the following:

$$PCC(g, j) = a(g) + b(g) \cdot PCTHE(j) + u(g, j); \quad (29)$$

$$g = 1, \dots, G,$$

where:

- j is the cluster of households,^{5/}
- $PCC(g, j)$ is the mean level of per capita household consumption of goods and services in commodity group g in household cluster j ,
- $PCTHE(j)$ is the mean level of per capita total household expenditure in household cluster j ,
- $u(g, j)$ is the random disturbance term for commodity group g in household cluster j .

The functions shown in equation (29) can be estimated using various regression techniques, such as ordinary least squares (OLS), using cross-section information on levels of per capita consumption by commodity group and the level of per capita total household expenditure.

ii. Extended linear expenditure system

To derive estimates of expenditure functions of this demand system, it would be necessary to rewrite the functions shown in equation (21) and add random disturbance terms to obtain:

$$PCC(g, j) = a(g) + b(g) \cdot PCDHI(j) + u(g, j); \quad (30)$$

$$g = 1, \dots, G,$$

where:

- $PCDHI(j)$ is the mean level of per capita disposable household income in household cluster j .

The functions shown in equation (30) could be estimated using a regression technique, such as OLS, using cross-section information on per capita consumption by commodity group and per capita disposable household income.

b. Urban-rural level

The demand systems that can be used to make urban-rural projections of household consumption and savings are urban-rural counterparts of the national-level linear expenditure systems. Hence, procedures to estimate the former systems are urban-rural equivalents of the procedures for estimating the national-level demand systems.

i. Linear expenditure system

Expenditure functions of the linear expenditure system for urban and rural areas can be estimated using an urban-rural equivalent of equation (29).

ii. Extended linear expenditure system

Expenditure functions of the extended linear expenditure system for urban and rural areas can be estimated using an urban-rural counterpart of equation (30).

(iii) Illustrative estimation

This section will illustrate procedures for estimating alternative demand systems, using two sets of cross-section data for clusters of households. The first part of this section will illustrate procedures to be used at the national level. The second part will illustrate procedures to be used at the urban-rural level.

a. National level

First, the estimation of national-level expenditure functions of the linear expenditure system will be illustrated. Then, the estimation of expenditure functions of the extended linear expenditure system will be described.

i. Linear expenditure system

To obtain estimates of the coefficients of the expenditure functions of the linear expenditure system, it is necessary to estimate the expenditure functions indicated in equation (29). The functions can be estimated from a data set such as that which is partially illustrated in table 71. The table (which is presented for illustrative purposes only) contains a small portion of a set of observations on the relevant variables for 363 clusters (of which 227 are urban and 136 are rural). The observations are on mean levels of per capita consumption by commodity group and mean levels of per capita total household expenditure. If the OLS regression technique is applied to the complete data set, a part of which is illustrated in table 71, the results will be those shown in table 72.

The results shown in table 72 are largely satisfactory as a basis for making projections of household consumption. All of the estimated partial coefficients of per capita household expenditure (column 3), which signify the proportions of total expenditure going to various commodity groups, are positive, as one would expect. Moreover (as indicated by t-statistics), the estimates of the partial coefficients are all statistically significant at the 0.01 level.

The coefficients of determination, R^2 's (column 4), vary between a high of 0.874 (for food) and a low of 0.159 (for transportation). Overall, their values are relatively high, which is mainly due to the fact that the observations used to estimate the functions are averages for clusters of households, most of which consist of four to eight households. If observations for individual households

Table 71. Illustrative data required to estimate expenditure functions of the linear expenditure system

Household cluster	Commodity group									Total expenditure	Location
	Food	Clothing	Housing	Fuel and light	Durables	Trans- portation	Personal care	Rec- reation	Services		
1	15.06	0.97	1.56	0.50	0.98	0.12	0.57	0.83	0.64	21.23	Rural
2	10.35	1.38	0.05	0.70	0.13	0.14	0.22	1.29	0.62	14.88	Urban
3	25.75	1.97	0.18	4.38	4.51	0.90	2.90	8.84	1.78	51.20	Rural
4	15.51	4.19	1.31	1.96	4.81	0.43	0.86	2.23	2.85	34.15	Urban
5	18.48	1.67	0.00	3.49	1.60	0.82	0.78	1.37	1.10	29.30	Rural
6	13.27	2.16	0.00	3.23	0.87	0.63	0.36	1.15	0.30	21.97	Urban
7	13.33	1.20	0.00	4.82	1.72	0.20	0.76	1.93	0.15	24.12	Rural
8	11.82	1.61	2.36	2.84	0.92	0.18	0.49	1.85	0.46	22.52	Urban
9	20.14	1.95	0.00	3.12	0.67	0.09	0.49	1.29	1.00	28.74	Rural
10	12.96	0.68	0.23	1.13	0.49	0.62	0.23	0.46	0.29	17.09	Urban

Table 72. Estimates of the coefficients of expenditure functions of the linear expenditure system for the entire country a/

Commodity group	Coefficients		
	Intercept	Total expenditure b/	R-square
(1)	(2)	(3)	(4)
Food	1.33676	0.52404 (49.94)	0.874
Clothing	0.23368	0.07371 (23.22)	0.599
Housing	-0.51392	0.05472 (9.14)	0.188
Fuel and light	1.01641	0.04882 (14.63)	0.372
Durables	-1.78524	0.13690 (21.21)	0.555
Transportation	0.12202	0.01033 (8.27)	0.159
Personal care	-0.01881	0.03095 (20.12)	0.529
Recreation	-0.14517	0.06829 (21.77)	0.568
Other services	-0.24570	0.05223 (11.87)	0.281

a/ Estimated by ordinary least squares (OLS).

b/ t values are shown in parentheses.

were used, the R^2 's would have been much lower. In view of the relatively low R^2 's for commodity groups such as housing and transportation, the forecast errors for those functions could be fairly high.

ii. The extended linear expenditure system

To obtain estimates of the coefficients of expenditure functions of the extended linear expenditure system at the national level, it would be necessary to estimate the functions indicated in equation (30). These functions can be estimated using a data set such as the one presented in part in table 73, which includes observations on mean levels of per capita household consumption by commodity groups and mean levels of per capita disposable household income. A part of such a data set for 363 clusters of households is presented in table 73. If the OLS regression technique is applied to the data illustrated in table 73, the results will be those shown in table 74.

The results shown in table 74 are somewhat less satisfactory as the basis for making projections than those obtained for the linear expenditure system (table 72). The estimates of all partial coefficients of per capita disposable household income (column 3) are positive, as expected, and all are statistically significant at the 0.01 level. However, the coefficients of determination (column 4), which vary between a high of 0.796 (for food) and a low of 0.155 (for housing) are on the average lower than those obtained by estimating the linear expenditure system. This may be due to the fact that it is more difficult to accurately measure the disposable income of a household than its total expenditure.

b. Urban-rural level

The estimation of the expenditure functions of the linear expenditure system and the extended linear expenditure system for urban and rural areas will be illustrated in this section. The data sets to be used will be those employed earlier to estimate the national-level expenditure functions of these two demand systems.

i. Linear expenditure system

To derive estimates of the expenditure functions of the linear expenditure system at the urban-rural level, it is necessary to estimate functions that are urban-rural equivalents of those indicated in equation (29). If the OLS regression method is employed along with the data for urban household clusters, which were partially illustrated in table 71, in order to estimate expenditure functions for the urban areas, the results will be those shown in table 75. The use of the same method with the data for rural household clusters, which are also partially shown in table 71, yields results presented in table 76.

For the most part, those results would be a satisfactory basis for projecting household consumption for urban and rural areas. The estimated partial coefficients of per capita total household expenditure (column 3) are positive and statistically significant at the 0.01 level in both tables. The R^2 's (column 4) vary roughly within the same range as in the case of the

Table 73. Illustrative data required to estimate expenditure functions of the extended linear expenditure system

Household cluster	Commodity group									Disposable income	Location
	Food	Clothing	Housing	Fuel and light	Durables	Trans portation	Personal care	Rec-reation	Services		
1	15.06	0.97	1.56	0.50	0.98	0.12	0.57	0.83	0.64	54.01	Rural
2	10.35	1.38	0.05	0.70	0.13	0.14	0.22	1.29	0.62	21.38	Urban
3	25.75	1.97	0.18	4.38	4.51	0.90	2.90	8.84	1.78	54.05	Rural
4	15.51	4.19	1.31	1.96	4.81	0.43	0.86	2.23	2.85	39.98	Urban
5	18.48	1.67	0.00	3.49	1.60	0.82	0.78	1.37	1.10	33.66	Rural
6	13.27	2.16	0.00	3.23	0.87	0.63	0.36	1.15	0.30	27.50	Urban
7	13.33	1.20	0.00	4.82	1.72	0.20	0.76	1.93	0.15	28.02	Rural
8	11.82	1.61	2.36	2.84	0.92	0.18	0.49	1.85	0.46	25.22	Urban
9	20.14	1.95	0.00	3.12	0.67	0.09	0.49	1.29	1.00	29.18	Rural
10	12.96	0.68	0.23	1.13	0.49	0.62	0.23	0.46	0.29	24.74	Urban

Table 74. Estimates of the coefficients of expenditure functions of the
of the extended linear expenditure system for the entire country a/

Commodity group	Coefficients		R- square
	Intercept	Disposable income b/	
(1)	(2)	(3)	(4)
Food	1.36077	0.45794 (37.56)	0.796
Clothing	0.19331	0.06566 (21.76)	0.567
Housing	-0.42820	0.04543 (8.13)	0.155
Fuel and light	1.08470	0.04077 (12.73)	0.310
Durables	-1.80769	0.12045 (19.49)	0.513
Transportation	-0.06711	0.01062 (9.52)	0.201
Personal care	-0.00237	0.02661 (17.77)	0.467
Recreation	-0.12022	0.05905 (19.25)	0.507
Other services	-0.35136	0.04874 (12.20)	0.292

a/ Estimated by ordinary least squares (OLS).

b/ t values are shown in parentheses.

Table 75. Estimates of the coefficients of expenditure functions of the linear expenditure system for urban areas a/

Commodity group	Coefficients			R-square
	Intercept	Total expenditure	b/	
(1)	(2)	(3)	(4)	
Food	2.58648	0.46537 (40.66)		0.880
Clothing	0.32526	0.07566 (20.75)		0.657
Housing	-0.84614	0.06412 (9.78)		0.298
Fuel and light	0.98829	0.04853 (11.52)		0.371
Durables	-2.33920	0.16270 (18.20)		0.596
Transportation	0.11803	0.01118 (7.24)		0.189
Personal care	-0.04373	0.02946 (22.88)		0.699
Recreation	-0.29012	0.07819 (21.92)		0.681
Other services	-0.49887	0.06478 (10.06)		0.310

a/ Estimated by ordinary least squares (OLS).

b/ t values are shown in parentheses.

Table 76. Estimates of the coefficients of expenditure functions of the linear expenditure system for rural areas a/

Commodity group	Coefficients			R-square
	Intercept	Total expenditure	b/	
(1)	(2)	(3)	(4)	
Food	-0.92037	0.65546 (42.40)		0.930
Clothing	-0.21438	0.06440 (10.84)		0.467
Housing	-0.05875	0.03856 (3.18)		0.070
Fuel and light	1.02948	0.05075 (8.82)		0.367
Durables	-0.78941	0.07925 (12.43)		0.536
Transportation	0.14453	0.00793 (3.59)		0.088
Personal care	-0.03589	0.03637 (10.22)		0.438
Recreation	0.18884	0.04369 (8.10)		0.329
Other services	0.22718	0.02358 (6.13)		0.219

a/ Estimated by ordinary least squares (OLS).
b/ t values are shown in parentheses.

national-level expenditure functions of the linear expenditure system, except for the rural functions for housing and transportation, which are below 0.10.

ii. Extended linear expenditure system

If urban-rural projections of household consumption and savings are to be prepared using the extended linear expenditure system, it will be necessary to estimate urban-rural equivalents of the expenditure functions indicated in equation (30). If those urban-rural functions are estimated with the OLS regression method using the means of the relevant variables for urban and rural household clusters shown in table 73, the results will be those shown in tables 77 and 78.

The results shown in those tables provide a less satisfactory basis for making projections of household consumption and savings than those shown in tables 75 and 76. The coefficients of the disposable income variable (column 3) are all positive and highly significant. However, the coefficients of determination (column 4), which vary between a high of 0.838 (for food in the rural areas) and a low of 0.072 (for housing in those same areas), are on the average lower than those obtained in estimating the expenditure functions of the linear expenditure system.

(c) Calibration of the empirically estimated functions

After obtaining satisfactory estimates of the relevant functions of the chosen demand system, the planner will sometimes desire to make special adjustments in the estimated intercept coefficients. (Adjustments in the estimated partial coefficients would not be desirable in view of the fact that they would alter the coefficients in such a way that the adjusted partial coefficients would no longer add up to one in the case of the linear expenditure system or to the estimated aggregate marginal propensity to consume in the case of the extended linear expenditure system.)

The adjustments, which are normally referred to as "calibration", ensure that once adjusted, the functions are capable of precisely reproducing the levels of per capita household consumption by commodity group for a particular year or group of years given the values of explanatory variables for that year or group of years. If left unadjusted, the functions will be capable of producing mean levels of per capita household consumption by commodity group for the year to which data used in estimating the functions refer, using the average levels of explanatory variables for the year. The calibration procedures for expenditure functions of the two demand systems are described in annex III.

This completes the section on preparation of the projection inputs. The following section will illustrate how the procedures described in this chapter can be used to project household consumption and savings.

D. Illustrative examples of projections

This section will present two examples illustrating the use of the two linear expenditure systems in projecting household consumption and savings. The

Table 77. Estimates of the coefficients of expenditure functions of the extended linear expenditure system for urban areas a/

Commodity group	Coefficients		R-square
	Intercept	Disposable income b/	
(1)	(2)	(3)	(4)
Food	2.51964	0.41002 (30.45)	0.805
Clothing	0.32563	0.06637 (18.19)	0.595
Housing	-0.66433	0.05144 (8.10)	0.226
Fuel and light	1.09616	0.03972 (9.65)	0.293
Durables	-2.38226	0.14387 (16.53)	0.548
Transportation	0.03763	0.01193 (8.74)	0.254
Personal care	-0.04583	0.02590 (19.86)	0.637
Recreation	-0.27931	0.06831 (18.85)	0.612
Other services	-0.65838	0.06105 (10.39)	0.324

a/ Estimated by ordinary least squares (OLS).

b/ t values are shown in parentheses.

Table 78. Estimates of the coefficients of expenditure functions of the extended linear expenditure system for rural areas a/

Commodity group	Coefficients		
	Intercept	Disposable income <u>b/</u>	R-square
(1)	(2)	(3)	(4)
Food	-0.69831	0.56330 (26.29)	0.838
Clothing	0.12400	0.05910 (11.11)	0.479
Housing	-0.10949	0.03527 (3.22)	0.072
Fuel and light	1.04888	0.04354 (8.11)	0.329
Durables	-0.79580	0.06922 (11.53)	0.498
Transportation	0.12197	0.00766 (3.85)	0.100
Personal care	0.00746	0.03022 (8.85)	0.369
Recreation	0.23438	0.03652 (7.22)	0.280
Other services	0.18381	0.02199 (6.36)	0.232

a/ Estimated by ordinary least squares (OLS).

b/ t values are shown in parentheses.

first example will show how to prepare a national projection using a procedure based on the linear expenditure system. The second example will illustrate the preparation of an urban-rural projection employing a procedure based on the extended linear expenditure system. These examples will indicate how the relevant calculations are made for the projection interval 0-5. In addition, they will provide complete projection results for a 20-year period.

1. National projection

The calculations presented in this example will be based on the inputs contained in table 79, panel A, which shows projected levels of per capita disposable household income and projected population size for dates five years apart, starting with the initial year of the projection, which is denoted as year 0. Also shown in the panel are assumptions on the average household savings ratio for those same dates. The calculation will also use the coefficients of the expenditure functions of the linear expenditure system shown in panel B. The slope coefficients are those presented in table 72. The intercept coefficients were adjusted as explained in annex III and shown in table 96.

(a) Levels of per capita household consumption and savings

To project per capita household consumption and savings, it is initially necessary to calculate per capita total expenditure. The next steps would be to project the levels of per capita household consumption by commodity group and per capita household savings.

(i) Per capita total household expenditure

The level of per capita total household expenditure for a given date can be obtained as a product of the per capita disposable household income and the complement of the assumed average household savings ratio. Thus, per capita total expenditure for the end of the projection interval 0-5, 33.7, can be obtained as follows:

$$33.7 = (39.7) [1 - 0.15]; \quad (2)$$

where 39.7 is the per capita disposable household income for year 5 and 0.15 is the average household savings ratio for the same date.

(ii) Levels of per capita household consumption by commodity group

To derive levels of per capita household consumption by commodity group for a given date using the linear expenditure system, one should evaluate the estimates of the expenditure functions using the per capita total household expenditure for that date. The projection of per capita household consumption is illustrated in table 80. In particular, the level of per capita household consumption for each commodity group in year 5 (column 5) is obtained by adding the adjusted intercept coefficient for the commodity group (column 2) to a number which is the product of the estimate of the per capita total household

Table 79. Inputs for projecting household consumption and savings for the entire country using the linear expenditure system

PANEL A: Projected household income and population size along with assumptions on household savings					
Variable	Year				
	0	5	10	15	20
Per capita disposable household income (LCUs) <u>a/</u>	33.8	39.7	47.1	56.6	69.7
Population size (in thousands)	10 000.0	11 210.4	12 619.0	14 159.4	15 675.6
Average savings ratio	0.14	0.15	0.16	0.17	0.18

PANEL B: Estimates of the coefficients of expenditure functions of the linear expenditure system		
Commodity group	Adjusted intercept coefficient <u>b/</u>	Total expenditure coefficient <u>c/</u>
Food	1.60774	0.52404
Clothing	0.24142	0.07371
Housing	-0.45913	0.05472
Fuel and light	0.95603	0.04882
Durables	-1.90047	0.13690
Transportation	0.12832	0.01033
Personal care	0.01601	0.03095
Recreation	-0.26602	0.06829
Other services	-0.32364	0.05223

a/ Local currency units.

b/ From table 95, col. 5.

c/ From table 72, col. 3.

Table 80. Deriving levels of per capita household consumption by commodity group entire country, year 5

Commodity group	Estimates of the coefficients of expenditure functions <u>a/</u>		Per capita total expenditure <u>b/</u> (LCUs <u>d/</u>)	Projected level of per capita household consumption <u>c/</u> (LCUs <u>d/</u>)
	Adjusted intercept coefficient	Total expenditure coefficient		
(1)	(2)	(3)	(4)	(5)
Food	1.60774	0.52404	33.7	19.2
Clothing	0.24142	0.07371	33.7	2.7
Housing	-0.45913	0.05472	33.7	1.3
Fuel and light	0.95603	0.04882	33.7	2.6
Durables	-1.90047	0.13690	33.7	2.7
Transportation	0.12832	0.01033	33.7	0.4
Personal care	0.01601	0.03095	33.7	1.0
Recreation	-0.26602	0.06829	33.7	2.0
Other services	-0.32364	0.05223	33.7	1.4
Total		1.00000		33.7

a/ From table 79, panel B.

b/ Calculation illustrated in text.

c/ (Col. 2) + (col. 3) . (col. 4).

d/ Local currency units.

expenditure coefficient for a commodity group (column 3) and the level of per capita total household expenditure in year 5 (column 4).

For example, the level of per capita household consumption for food in year 5, 19.3, is obtained as:

$$19.3 = 1.60775 + (0.52404) (33.7); \quad (3)$$

where 1.60775 is the adjusted intercept coefficient for food; 0.52404 is the estimate of the total expenditure coefficient for food and 33.7 is the projected level of per capita total expenditure in year 5.

(iii) Level of per capita household savings

After the projected per capita disposable household income and per capita total household expenditure have been calculated, the level of per capita household savings can be obtained as the difference between the two. Thus, the per capita household savings for the end of the projection interval 0-5, 6.0, is:

$$6.0 = 39.7 - 33.7; \quad (4)$$

where 39.7 is the per capita disposable household income and 33.7 is the per capita total household expenditure for year 5.

If the calculations illustrated above are performed for the relevant dates over the entire projection period, the result will be the projected levels of per capita household consumption and savings for the entire period. The levels obtained as part of this illustrative example are shown in table 81.

(b) Levels of household consumption by commodity group and levels of household savings

Once the projected levels of per capita household consumption and savings are obtained, the levels of household consumption for each commodity group and the levels of household savings can be calculated by multiplying the per capita levels by the population size.

(i) Household consumption by commodity group

For example, household consumption of food at the end of the projection interval 0-5, 216.3, can be calculated as:

$$216.3 = (19.3) (11,210.4), \quad (5)$$

where 19.3 is the projected level of per capita consumption of food and 11,210.4 is the projected population size in year 5.

(ii) Household savings

The level of household savings at the end of the interval 0-5, 66.8, can be obtained as:

Table 81. Projected levels of per capita household consumption by commodity group and per capita household savings

(LCUs) a/

Commodity group/ savings	Year				
	0	5	10	15	20
Food	16.8	19.2	22.3	26.2	31.5
Clothing	2.3	2.7	3.1	3.7	4.4
Housing	1.1	1.3	1.7	2.1	2.6
Fuel and light	2.3	2.6	2.8	3.2	3.7
Durables	2.0	2.7	3.5	4.5	5.9
Transportation	0.4	0.4	0.5	0.6	0.7
Personal care	0.9	1.0	1.2	1.4	1.7
Recreation	1.7	2.0	2.4	2.9	3.6
Other services	1.1	1.4	1.7	2.1	2.6
Total expenditure	29.0	33.7	39.5	46.9	57.1
Savings	4.7	5.9	7.5	9.6	12.5
Disposable income	33.8	39.7	47.1	56.6	69.7

a/ Local currency units.

$$66.8 = (6.0) (11,210.4), \quad (6)$$

where 6.0 is the level of per capita savings in year 5.

These calculations can be performed for the relevant dates over the entire projection period to obtain the levels of household consumption and savings for the period, as shown in table 82.

(c) Other results^{6/}

Other results that may be useful in planning can be obtained as part of this projection. They include various household consumption and savings aggregates, indicators of the spending pattern of households and rates of growth of household consumption and savings.^{2/}

(i) Household consumption and savings aggregates

Aggregates that can be derived from the consumption and savings projections include total household consumption along with the levels of household consumption in various broad commodity groups. They also include increases in total household consumption, increases in household consumption by broad commodity groups and increases in household savings over the intervening intervals.

a. Total household consumption

Total household consumption at the end of a given projection interval is obtained by aggregating the projected levels of household consumption by commodity group. Thus, total household consumption in year 5, 378.3, is computed by adding the projected levels of household consumption in the various commodity groups. This number is shown in table 83 (in the column corresponding to year 5) along with other results derived for the entire 20-year projection period. The change in total household consumption over this period is indicated in figure XXIV.

Also shown in table 83 and figure XXIV are levels and changes in household savings over the 20-year projection period.

b. Household consumption by broad commodity groups

Household consumption in broad commodity groups can be obtained by aggregating projected household consumption for the various primary commodity groups, such as those ranging from food to other services, using appropriate aggregation rules. To illustrate this aggregation, it will be assumed that there are three broad groups: "food", "clothing" and "other", the first two of which are identical to the first two primary commodity groups, while the third is an aggregation of the primary commodity groups ranging from housing to other services.

Therefore, household consumption of "food" in year 5, 216.3, is obtained as:

$$216.3 = 216.3; \quad (8)$$

Table 82. Projected levels of household consumption by commodity group and household savings

(Thousands of LCUs) a/

Commodity group/ savings	Year				
	0	5	10	15	20
Food	168405	216265	281920	371347	494704
Clothing	23840	30590	39847	52449	69823
Housing	11314	15553	21525	29897	41827
Fuel and light	23751	29185	36438	46011	58725
Durables	20789	30483	44366	64153	92861
Transportation	4285	5346	6776	8688	11266
Personal care	9156	11887	15654	20814	27980
Recreation	17190	22851	30737	41658	57012
Other services	11945	16130	21992	30159	41720
Total expenditure	290680	378294	499258	665180	895923
Savings	47320	66757	95096	136241	196666
Disposable income	338000	445052	594354	801422	1 092589

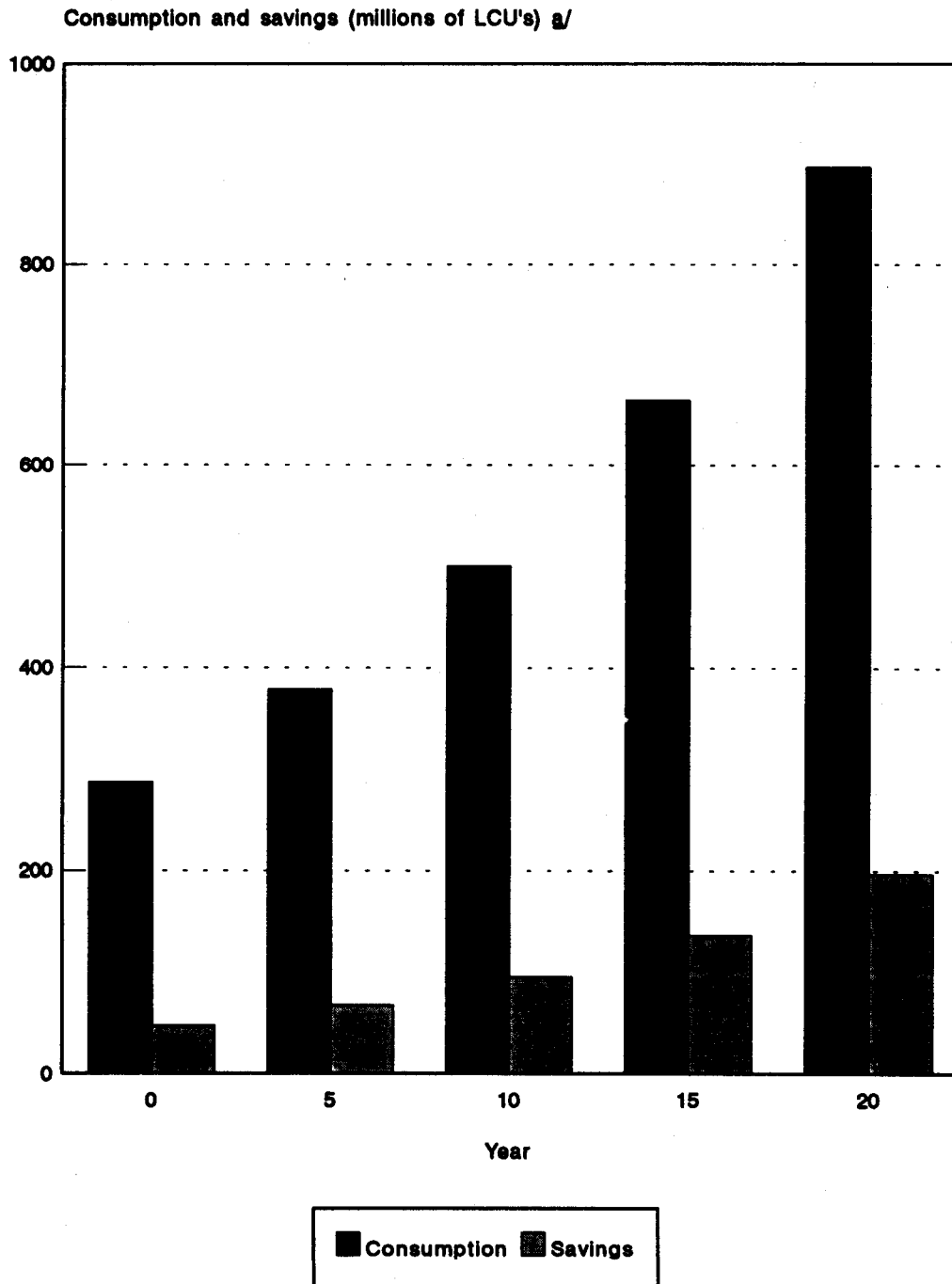
a/ Local currency units.

Table 83. Household consumption and savings aggregates, indicators of the pattern of household spending and rates of household consumption and savings change for the entire country

Indicators	Year				
	0	5	10	15	20
Household consumption and savings aggregates (in millions LCUs) a/					
Levels of household consumption and savings:					
Total consumption	290.7	378.3	499.3	665.2	895.9
Food	168.4	216.3	281.9	371.3	494.7
Clothing	23.8	30.6	39.8	52.4	69.8
Other	98.4	131.4	177.5	241.4	331.4
Savings	47.3	66.8	95.1	136.2	196.7
Growth in household consumption and savings:					
Total consumption		87.6	121.0	165.9	230.7
Food		47.9	65.7	89.4	123.4
Clothing		6.8	9.3	12.6	17.4
Other		33.0	46.1	63.9	90.0
Savings		19.4	28.3	41.1	60.4
Indicators of the household spending pattern					
Proportions of disposable household income spent or saved					
Food	0.50	0.49	0.47	0.46	0.45
Clothing	0.07	0.07	0.07	0.07	0.06
Other	0.29	0.30	0.30	0.30	0.30
Savings	0.14	0.15	0.16	0.17	0.18
Rates of growth of household consumption and savings					
Total consumption		5.41	5.71	5.91	6.14
Food		5.13	5.45	5.66	5.90
Clothing		5.11	5.43	5.65	5.89
Other		5.95	6.19	6.34	6.54
Savings		7.13	7.33	7.46	7.62

a/ Local currency units.

Figure XXIV. Total household consumption and savings



a/ Local currency units.

where 216.3 on the right-hand side is the projected level of household consumption of food for year 5.

Household consumption of "clothing" in year 5, 30.6, is obtained as:

$$30.6 = 30.6; \quad (8)$$

where 30.6 on the right-hand side is the projected level of household consumption of clothing in year 5.

Household consumption of "other" goods and services in year 5, 131.4, is obtained as:

$$131.4 = 15.6 + 29.2 + 30.5 + 5.3 + 11.9 + 22.9 + 16.1; \quad (8)$$

where the numbers on the right-hand side, 15.6 through 16.1, are respectively projected levels of household consumption of housing through that of other services in year 5.

Household consumption by broad commodity groups obtained for the different dates over the projection period is shown in table 83 and presented in figure XXV.

c. Growth in total household consumption

The growth in total household consumption over a given projection interval equals the difference between total household consumption at the end of the interval and total household consumption at its beginning. For the interval 0-5, the growth in total household consumption, 91.9, is obtained as:

$$91.9 = 378.3 - 286.4; \quad (9)$$

where 286.4 and 378.3 are, respectively, total household consumption at the beginning and the end of the interval (shown in columns corresponding to years 0 and 5, respectively, in table 83).

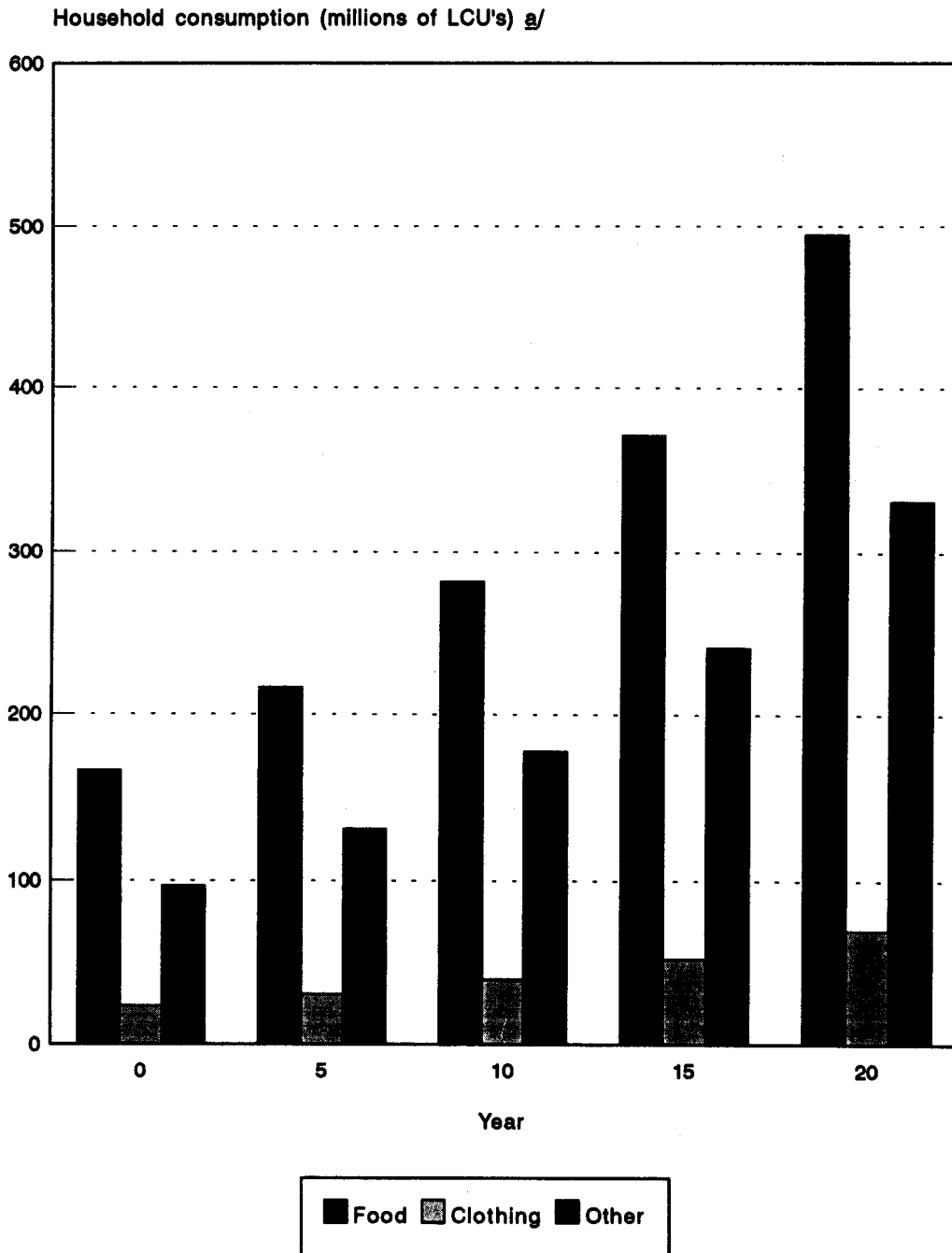
d. Growth in household consumption by broad commodity groups

The increase in household consumption in each broad commodity group over a projection interval is obtained as the difference between the levels of household consumption in that group at the end and the beginning of the interval. For example, for the interval 0-5, the growth of household consumption of food, 50.1, is:

$$50.1 = 216.3 - 166.2; \quad (10)$$

where 166.2 and 216.3 are, respectively, the levels of household consumption of food in years 0 and 5.

Figure XXV. Household consumption by broad groups
(food, clothing and other)



a/ Local currency units.

e. Growth in household savings

The growth in household savings over a given interval can be obtained as the difference between household savings at the end of the interval and household savings at its beginning. For the interval 0-5, the growth in household savings, 20.1, is:

$$20.1 = 66.8 - 46.6; \quad (11)$$

where 46.6 and 66.8 are, respectively, household savings at the beginning and the end of the interval (see columns corresponding to years 0 and 5).

(ii) Indicators of spending pattern of household

To obtain proportions of disposable income that are spent on various commodities and saved, it is initially necessary to obtain disposable household income.

a. Disposable household income

Disposable household income for the end of a given projection interval can be obtained as a product of the per capita disposable household income and the population size at that date. Thus, disposable household income for the end of the interval 0-5, 445.1, is obtained as follows:

$$445.1 = (39.7) \cdot (11,210.4); \quad (12)$$

where 39.7 is the per capita disposable household income in year 5 and 11,210.4 is the population size in that year.

b. Proportions of disposable household income spent on goods and services in broad commodity groups

For the end of a given interval, the proportion of disposable household income spent on goods and services in each broad commodity group can be obtained as the level of household consumption of goods and services in a given broad commodity group, divided by the level of disposable household income. Thus, the proportion of household disposable income spent on food at the end of the interval 0-5, 0.49, is:

$$0.49 = 216.3 / 445.1; \quad (13)$$

where 216.3 is the level of household consumption of food and 445.1 is the disposable household income in year 5.

c. Proportion of disposable household income saved

The proportion of disposable household income saved at a given date can be obtained by dividing the level of household savings by disposable household income at that date. Thus, for the end of the projection interval 0-5, this proportion, 0.15, is obtained as follows:

$$0.15 = 66.8 / 445.1;$$

(14)

where 66.8 is the level of household savings in year 5.

The proportions of disposable household income spent on goods and services in broad commodity groups and the proportion saved for the various dates are presented in table 83. The proportions obtained for the initial and the terminal year of the 20-year projection period are illustrated in figure XXVI.

(iii) Rates of growth of household consumption and savings

Rates of growth of household consumption can be calculated for total household consumption and for household consumption by broad commodity groups. It is also possible to compute rates of growth of household savings. These growth rates can be computed using either the geometric growth rate or the exponential growth rate depending on the treatment of time.

a. Rate of growth of total household consumption

i. Geometric growth

If growth in household consumption is assumed to occur over discrete intervals, the average annual growth rate of total household consumption for a given interval is obtained using the geometric growth rate formula. For the projection interval 0-5, this annual growth rate, 5.72 per cent (table 83), is obtained as follows:

$$5.72 = [(378.3/286.4)^{1/5} - 1] \cdot 100; \quad (15)$$

where 286.4 and 378.3 are the levels of total household consumption in years 0 and 5, respectively, and 5 is the length of the interval.

Rates of growth of total household consumption over the 20-year projection period that were computed using the geometric growth rate formula are shown in figure XXVII.

ii. Exponential growth

If the planner assumes that growth in household consumption is continuous, the average annual growth rate of total household consumption for a given interval is obtained by substituting the same data as above in the exponential growth rate formula. For the projection interval 0-5, this annual growth rate, 5.57 per cent, is obtained as follows:

$$5.57 = [\ln (378.3/286.4) / 5] \cdot 100; \quad (16)$$

b. Rates of growth of household consumption by broad commodity groups

i. Geometric growth

Assuming discrete growth, the rates of increase in household consumption

Figure XXVI. Proportions of disposable household income spent or saved in the initial and the terminal year

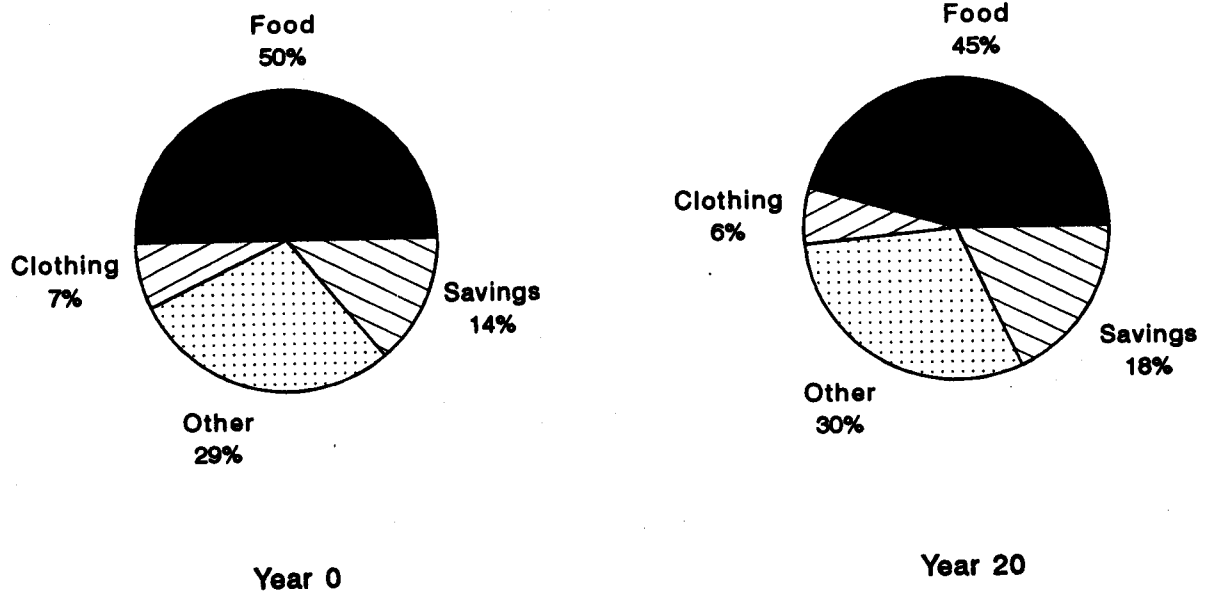
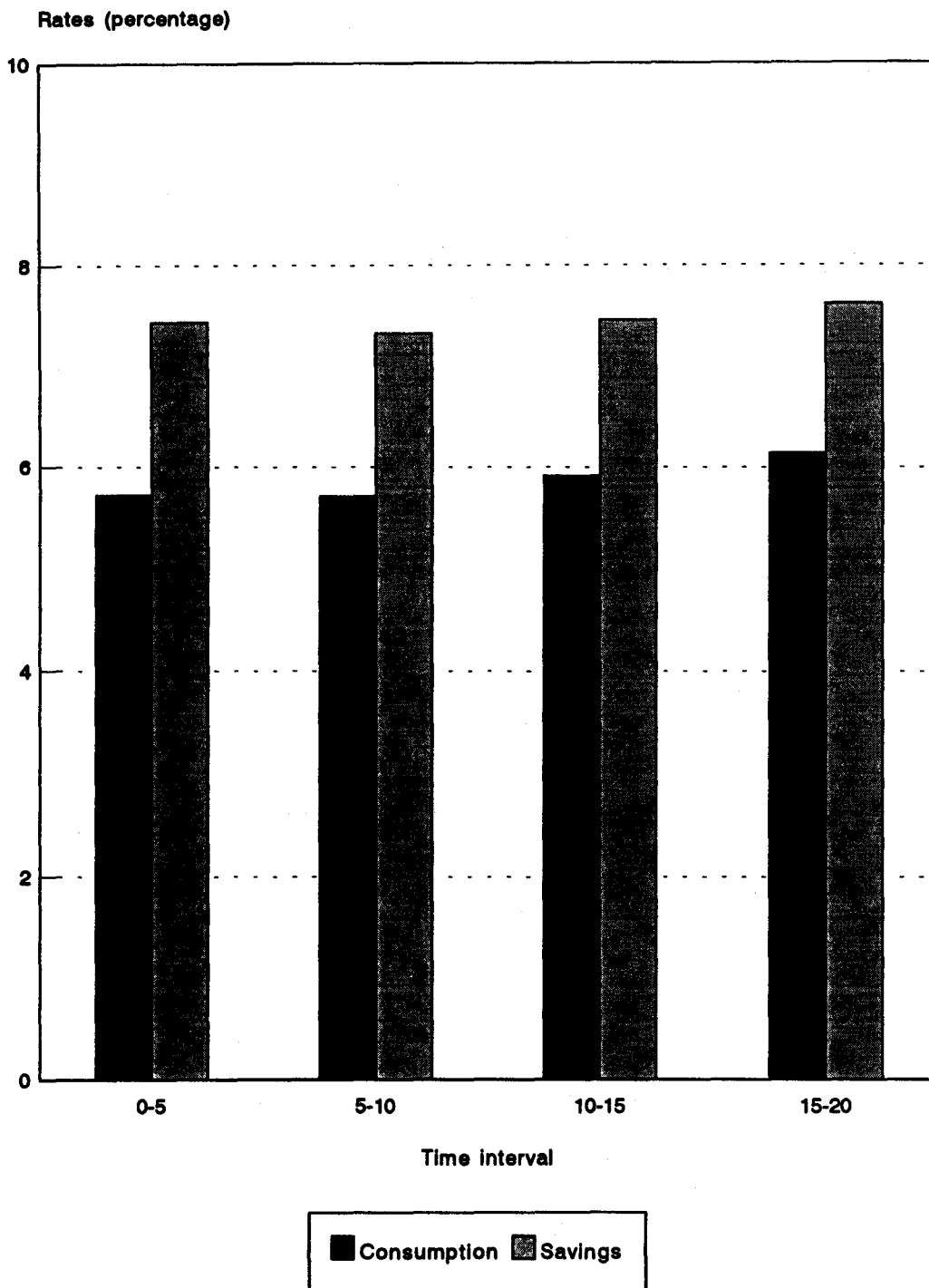


Figure XXVII. Rates of growth of total household consumption and savings



by broad commodity groups can be obtained in a way analogous to that used to calculate the rate of growth of total household consumption. Thus, the rate of increase of household consumption of food for the interval 0-5, 5.41 per cent, is calculated as follows:

$$5.41 = [(216.3/166.2)^{1/5} - 1] \cdot 100; \quad (17)$$

where 166.2 and 216.3 are the levels of household consumption of food in years 0 and 5, respectively.

Geometric rates of growth of household consumption by broad commodity groups over the 20-year projection interval are shown in figure XXVIII.

ii. Exponential growth

If continuous growth is assumed, rates of growth of household consumption by broad groups can be calculated using the exponential growth rate formula. The calculations can be performed by steps indicated by equation (18).

c. Rate of growth of household savings

i. Geometric growth

Assuming that household savings grow over discrete intervals, the average annual growth rate of household savings for a given interval is obtained by means of the geometric growth rate formula. For the projection interval 0-5, this annual growth rate, 7.44 per cent (table 83), is obtained as follows:

$$7.44 = [(66.8/46.6)^{1/5} - 1] \cdot 100; \quad (19)$$

where 46.6 and 66.8 are the levels of household savings in years 0 and 5, respectively.

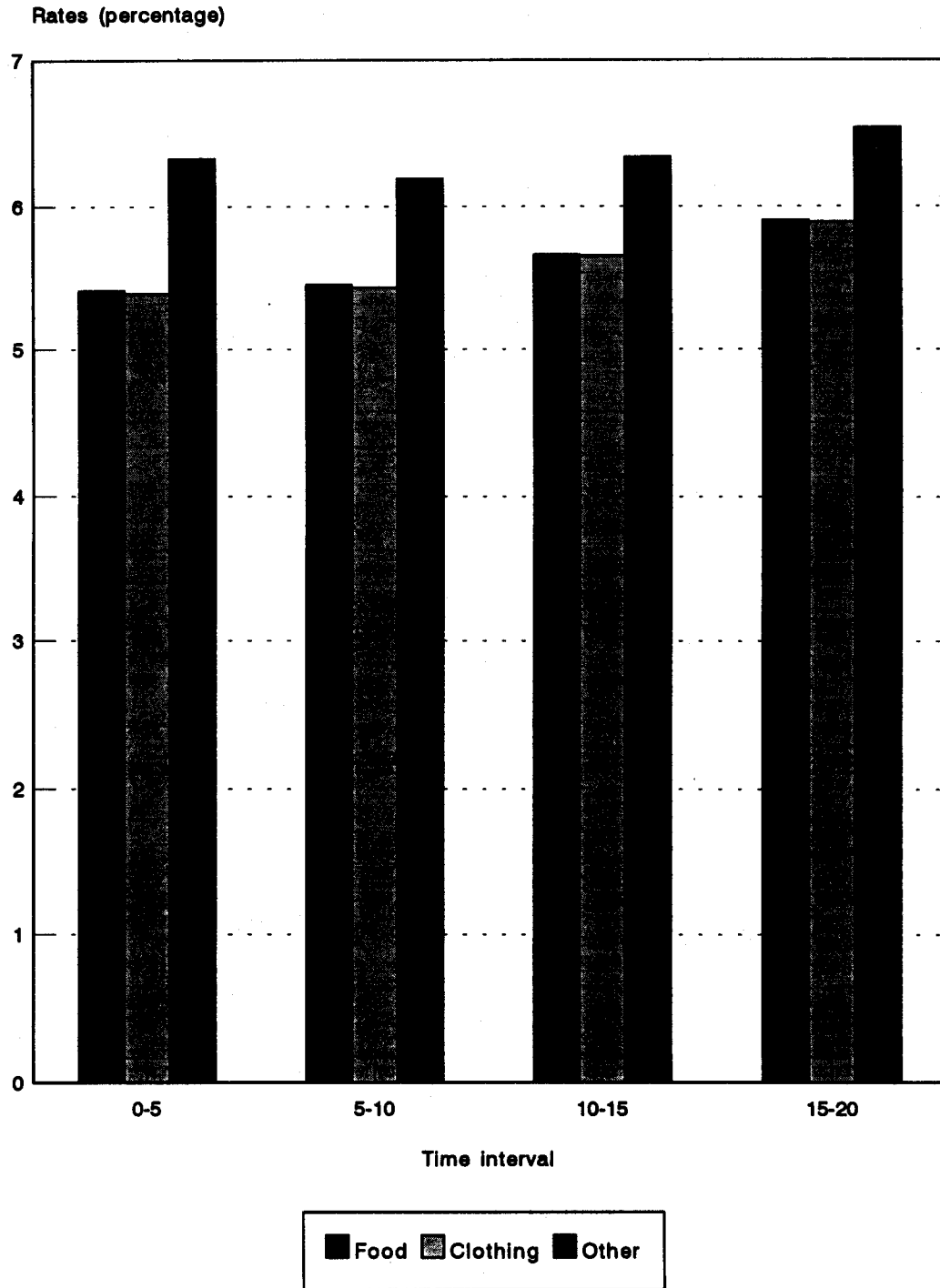
Rates of growth of household savings over the entire projection period that were computed using the geometric growth rate formula are shown in figure XXVII.

ii. Exponential growth

Assuming that growth in household savings is continuous, the average annual growth rate of household savings for a given interval can be obtained by substituting the same data as above in the exponential growth rate formula. For the projection interval 0-5, this annual growth rate, 7.20 per cent, is obtained as follows:

$$7.20 = [\ln (66.8/46.6) / 5] \cdot 100; \quad (20)$$

Figure XXVIII. Rates of growth of household consumption by broad commodity groups



2. Urban-rural projection

The previous section illustrated the procedure for projecting household consumption and savings at the national level, based on the linear expenditure system. The present example will illustrate the procedure for preparing an urban-rural projection of household consumption and savings, based on the extended linear expenditure system.

The inputs for urban and rural areas are shown in tables 84 and 85, respectively. These inputs include projected levels of per capita disposable household income and projected population sizes for urban and rural areas. The tables also show estimates of the slope coefficients of expenditure functions of the extended linear expenditure system for urban and rural areas, which were taken from tables 77 and 78. The adjusted intercepts of those functions, which are also shown in tables 84 and 85, have been obtained as described in annex III and shown in tables 96 and 97.

The example will focus on the calculations that are unique to the steps based on the extended linear expenditure system and projections for urban and rural areas.

(a) Levels of per capita household consumption and savings

The first step involved in projecting levels of per capita household consumption and savings using the procedure based on the extended linear expenditure system is to derive projected levels of per capita household consumption by commodity group.

(i) Levels of per capita household consumption by commodity group

Projecting the levels of per capita consumption for urban and rural areas for a given date involves evaluating expenditure functions for the various commodity groups for those areas using projected levels of per capita disposable income for urban and rural areas for the date in question. As illustrated in table 86, per capita consumption in the urban areas for the end of the projection interval 0-5, for each commodity group in the urban areas (column 5), is obtained by adding the adjusted urban intercept coefficient (column 2) to a number which is the product of the estimated urban disposable income coefficient (column 3) and the projected per capita urban disposable income (column 4).

For example, the level of per capita consumption of food for the urban areas in year 5, 23.8, is obtained as:

$$23.8 = 3.23772 + (0.41002) (50.2),$$

where 3.23772 is the adjusted intercept coefficient in the function for food for the urban areas; 0.41002 is the estimate of the household income coefficient in the urban expenditure function for food and 50.2 is the projected urban per capita disposable household income in year 5.

Table 84. Inputs for projecting household consumption and savings for urban areas using the extended linear expenditure system

Panel A. Projected per capita disposable household income and population size					
Variable	Year				
	0	5	10	15	20
Per capita disposable household income (LCUs) <u>a/</u>	48.9	50.2	53.8	60.6	70.7
Population size (thousands)	2 983.4	4 067.0	5 334.3	6 697.3	8 140.9

Panel B. Estimates of the coefficients of expenditure functions of the extended linear expenditure system		
Commodity group	Adjusted intercept coefficient <u>b/</u>	Disposable income coefficient <u>c/</u>
Food	3.23772	0.41002
Clothing	0.46251	0.06637
Housing	-1.09695	0.05144
Fuel and light	1.36650	0.03972
Durables	-3.40955	0.14387
Transportation	0.05627	0.01193
Personal care	-0.08729	0.02590
Recreation	-0.46241	0.06831
Other services	-1.01718	0.06105

a/ Local currency units.
b/ From table 96, col. 5.
c/ From table 77, col. 3.

Table 85. Inputs for projecting household consumption and savings for rural areas using the extended linear expenditure system

Panel A. Projected per capita disposable household income and population size					
Variable	Year				
	0	5	10	15	20
Per capita disposable household income (LCUs) a/	25.7	31.6	39.2	48.8	62.6
Population size (thousands)	7 016.6	7 130.6	7 258.0	7 433.5	7 503.1

Panel B. Estimates of the coefficients of expenditure functions of the extended linear expenditure system					
Commodity group	Adjusted intercept coefficient b/	Disposable income coefficient c/			
Food	-0.91710	0.56330			
Clothing	0.19755	0.05910			
Housing	-0.01696	0.03527			
Fuel and light	0.80679	0.04354			
Durables	-0.65259	0.06922			
Transportation	0.11822	0.00766			
Personal care	-0.02712	0.03022			
Recreation	0.15338	0.03652			
Other services	0.18817	0.02199			

- a/ Local currency units.
b/ From table 97, col. 5.
c/ From table 78, col. 3.

Table 86. Deriving levels of per capita household consumption by commodity group for urban areas: end of projection interval 0-5

Commodity group	Estimates of the coefficients of expenditure functions a/		Estimates of the coefficients	
	Adjusted intercept coefficient	Disposable income coefficient	Per capita disposable income in year 5 b/ (LCUs) d/	Projected level of per capita household consumption in year 5 c/ (LCUs) d/
(1)	(2)	(3)	(4)	(5)
Food	3.23772	0.41002	50.2	23.8
Clothing	0.46251	0.06637	50.2	3.8
Housing	-1.09695	0.05144	50.2	1.5
Fuel and light	1.36650	0.03972	50.2	3.4
Durables	-3.40955	0.14387	50.2	3.8
Transportation	0.05627	0.01193	50.2	0.7
Personal care	-0.08729	0.02590	50.2	1.2
Recreation	-0.46241	0.06831	50.2	3.0
Other services	-1.01718	0.06105	50.2	2.0
Total		0.87861		43.2

a/ From table 84, panel B.

b/ From table 84, panel A.

c/ (Col. 2) + (col. 3) . (col. 4).

d/ Local currency units.

(ii) Level of per capita total household consumption

Given the projected levels of per capita consumption by commodity groups, the level of per capita total household consumption can be obtained as the sum of those projected levels. Thus, for the end of the projection interval 0-5, the level of per capita total household consumption in the urban areas, 43.2, is obtained as:

$$43.2 = 23.8 + 3.8 + 1.5 + 3.4 + 3.8 + 0.7 + 1.2 + 3.0 + 2.0,$$

where the numbers on the right-hand side are the projected levels of per capita household consumption for the urban areas in year 5 (column 5, table 86).

(iii) Level of per capita household savings

Given the projected level of per capita total household consumption by commodity group for each area, the projected per capita household savings can be obtained as the difference between the projected per capita disposable household income and the projected per capita total household consumption.

Thus, the level of per capita household savings for the urban areas in year 5, 7.0, is obtained as:

$$7.0 = 50.2 - 43.2,$$

where 50.2 is the level of per capita disposable household income in year 5 and 43.2 is the level of per capita total consumption in that year.

Performing the calculations illustrated above for urban and rural areas for the relevant dates over the entire projection period produces the projected levels of per capita household consumption and savings for the two areas for the entire period. The per capita levels obtained for urban and rural areas as part of this illustrative example are shown respectively in tables 87 and 88.

(iv) Levels of household consumption and savings

Projected levels of household consumption and savings in urban and rural areas for a given projection date can be obtained in a way that is analogous to that used to derive projected levels of household consumption and savings at the national level. In particular, those levels in either area can be derived as products of the projected levels of per capita consumption and savings, on the one hand, and the projected population size, on the other. Projected levels of household consumption and savings for urban and rural areas over the 20-year projection period are shown in tables 89 and 90.

Projected levels of household consumption and savings can be aggregated across locations to obtain levels of household consumption and savings for the entire country. The levels of consumption and savings, which are obtained as part of this example, are indicated in table 91.

Table 87. Projected levels of per capita household consumption by commodity group and per capita household savings for urban areas

(LCUs) a/

Commodity group/ savings	Year				
	0	5	10	15	20
Food	23.2	23.8	25.2	28.0	32.2
Clothing	3.7	3.7	4.0	4.4	5.2
Housing	1.4	1.4	1.6	2.0	2.5
Fuel and light	3.3	3.3	3.5	3.7	4.2
Durables	3.6	3.8	4.3	5.3	6.8
Transportation	0.6	0.6	0.6	0.7	0.8
Personal care	1.1	1.2	1.3	1.4	1.7
Recreation	2.8	2.9	3.2	3.6	4.4
Other services	1.9	2.0	2.2	2.6	3.3
Total consumption	42.0	43.1	46.3	52.2	61.2
Savings	6.8	7.0	7.4	8.3	9.5
Disposable income	48.9	50.2	53.8	60.6	70.7

a/ Local currency units.

Table 88. Projected levels of per capita household consumption by commodity group and per capita household savings for rural areas

(LCUs) a/

Commodity group/ savings	Year				
	0	5	10	15	20
Food	13.55	16.88	21.16	26.57	34.35
Clothing	1.71	2.06	2.51	3.08	3.90
Housing	0.88	1.09	1.36	1.70	2.19
Fuel and light	1.92	2.18	2.51	2.93	3.53
Durables	1.12	1.53	2.06	2.72	3.68
Transportation	0.31	0.36	0.41	0.49	0.60
Personal care	0.74	0.92	1.15	1.44	1.86
Recreation	1.09	1.30	1.58	1.93	2.44
Other services	0.75	0.88	1.05	1.26	1.56
Total consumption	22.1	27.2	33.8	42.1	54.1
Savings	3.57	4.35	5.37	6.64	8.49
Disposable income	25.7	31.6	39.2	48.8	62.6

a/ Local currency units.

Table 89. Projected levels of household consumption by commodity group and household savings for urban areas

(Millions of LCUs) a/

Commodity group/ savings	Year				
	0	5	10	15	20
Food	69.4	96.8	134.9	188.0	262.3
Clothing	11.0	15.4	21.5	30.0	42.09
Housing	4.2	6.0	8.9	13.5	20.7
Fuel and light	9.8	13.6	18.6	25.2	34.09
Durables	10.8	15.5	23.1	35.5	55.0
Transportation	1.9	2.6	3.7	5.2	7.3
Personal care	3.5	4.9	6.9	9.9	14.2
Recreation	8.5	12.0	17.1	24.6	35.6
Other services	5.8	8.3	12.0	17.9	26.9
Total consumption	125.3	175.5	247.0	350.2	497.9
Savings	20.5	28.6	39.9	55.6	77.6
Disposable income	145.8	204.1	286.9	405.8	575.6

a/ Local currency units.

Table 90. Projected levels of household consumption by commodity group and household savings for rural areas

(Millions of LCUs) a/

Commodity group/ savings	Year				
	0	5	10	15	20
Food	95.1	120.3	153.6	197.5	257.7
Clothing	12.0	14.7	18.2	22.9	29.2
Housing	6.2	7.8	9.9	12.6	16.4
Fuel and light	13.5	15.5	18.2	21.7	26.5
Durables	7.9	10.9	14.9	20.2	27.6
Transportation	2.2	2.5	3.0	3.6	4.5
Personal care	5.2	6.6	8.4	10.7	14.0
Recreation	7.6	9.3	11.5	14.3	18.3
Other services	5.2	6.2	7.6	9.3	11.7
Total consumption	155.2	194.2	245.5	313.3	406.0
Savings	25.0	31.0	38.9	49.4	63.7
Disposable income	180.3	225.3	284.5	362.7	469.7

a/ Local currency units.

Table 91. Projected levels of household consumption by commodity group and household savings for the entire country

(Millions of LCUs) a/

Commodity group/ savings	Year				
	0	5	10	15	20
Food	164.6	217.2	288.5	385.6	520.0
Clothing	23.1	30.1	39.7	52.9	71.2
Housing	10.4	13.8	18.8	26.1	37.1
Fuel and light	23.3	29.2	36.9	47.0	60.4
Durables	18.7	26.4	38.0	55.8	82.6
Transportation	4.1	5.2	6.7	8.8	11.8
Personal care	8.7	11.5	15.3	20.6	28.1
Recreation	16.2	21.3	28.6	39.0	53.8
Other services	11.1	14.6	19.7	27.3	38.5
Total consumption	280.6	369.7	492.6	663.5	903.9
Savings	45.6	59.7	78.8	105.0	141.2
Disposable income	326.2	429.4	571.4	768.6	1 045.2

a/ Local currency units.

(b) Other results

In the course of making an urban-rural projection one can also calculate a number of derived indicators, using steps that are identical to those employed in the national projection, which are, however, performed for urban and rural areas and the entire country. Those indicators include various household consumption and savings aggregates, indicators of the spending pattern of households and the various rates of growth of household consumption and savings. Furthermore, the results for the country as a whole also include proportions of household consumption and savings that are urban and rural. The results obtained for urban and rural areas and the entire country are presented in tables 92 through 94, respectively. These indicators, except for the proportions urban and rural, can be calculated using the steps illustrated in connection with the national projection.

Levels of total household consumption and savings for urban and rural areas, as well as the entire country, which were obtained for the 20-year projection period, are shown, respectively, in figures XXIX and XXX.

(i) Proportions of total household consumption that are urban and rural

The proportion of total household consumption that is urban at the end of the projection interval is calculated by dividing the total household consumption in the urban areas by the total household consumption for the entire country for the date. For the end of the interval 0-5, the proportion of total household consumption that is urban, 0.47, is obtained as:

$$0.47 = 175.5/369.8; \quad (25)$$

where 175.5 is the total household consumption in the urban areas and 369.8 is the total household consumption for the entire country in year 5 (shown in tables 92 and 94, respectively).

The proportion of total household consumption that is rural, 0.53, is calculated as a complement of the proportion urban:

$$0.53 = 1 - 0.47; \quad (26)$$

where 0.47 is the proportion of total household consumption that is urban.

The proportions of household consumption that are urban and rural, obtained for the 20-year projection period, are indicated in table 94 and figure XXXI.

(ii) Proportions of household savings that are urban and rural

The proportion of household savings that is urban is calculated by dividing the household savings in the urban areas by the household savings in

Table 92. Household consumption and savings aggregates, indicators of the pattern of household spending and rates of household consumption and savings change for urban areas

Indicators	Year				
	0	5	10	15	20
Household consumption and savings aggregates (millions of LCUs) a/					
Levels of household consumption and savings					
Total consumption	125.3	175.5	247.0	350.2	497.9
Food	69.4	96.8	134.9	188.0	262.3
Clothing	11.0	15.4	21.5	30.0	41.9
Other	44.8	63.2	90.6	132.0	193.6
Savings	20.5	28.6	39.9	55.6	77.6
Growth in household consumption and savings					
Total consumption		50.1	71.5	103.1	147.7
Food		27.4	38.0	53.1	74.2
Clothing		4.3	6.0	8.5	11.9
Other		18.4	27.4	41.4	61.5
Savings		8.1	11.2	15.7	21.9
Indicators of the household spending pattern					
Proportions of disposable household income spent or saved					
Food	0.47	0.47	0.47	0.46	0.45
Clothing	7.58	7.55	7.49	7.40	7.29
Other	0.30	0.30	0.31	0.32	0.33
Savings	0.14	0.14	0.13	0.13	0.13
Rates of growth of household consumption and savings					
Total consumption		6.96	7.07	7.22	7.29
Food		6.87	6.85	6.86	6.88
Clothing		6.88	6.87	6.89	6.91
Other		7.12	7.47	7.82	7.94
Savings		6.87	6.85	6.86	6.88

a/ Local currency units.

Table 93. Household consumption and savings aggregates, indicators of the pattern of household spending and rates of household consumption and savings change for rural areas

Indicators	Year				
	0	5	10	15	20
Household consumption and savings aggregates (millions of LCUs) a/					
Levels of household consumption and savings					
Total consumption	155.2	194.2	245.5	313.3	406.0
Food	95.1	120.3	153.6	197.5	257.6
Clothing	12.0	14.7	18.2	22.9	29.2
Other	48.0	59.1	73.6	92.9	119.0
Savings	25.0	31.0	38.9	49.4	63.6
Growth in household consumption and savings					
Total consumption		38.9	51.2	67.7	92.6
Food		25.2	33.2	43.9	60.1
Clothing		2.6	3.5	4.6	6.3
Other		11.0	14.5	19.2	26.1
Savings		6.0	7.9	10.4	14.2
Indicators of the household spending pattern					
Proportions of disposable household income spent or saved					
Food	0.52	0.53	0.53	0.54	0.54
Clothing	6.67	6.53	6.41	6.31	6.22
Other	0.26	0.26	0.25	0.25	0.25
Savings	0.13	0.13	0.13	0.13	0.13
Rates of growth of household consumption and savings					
Total consumption		4.58	4.79	4.99	5.31
Food		4.81	4.99	5.15	5.46
Clothing		4.10	4.38	4.65	5.00
Other		4.22	4.49	4.74	5.09
Savings		4.39	4.63	4.86	5.19

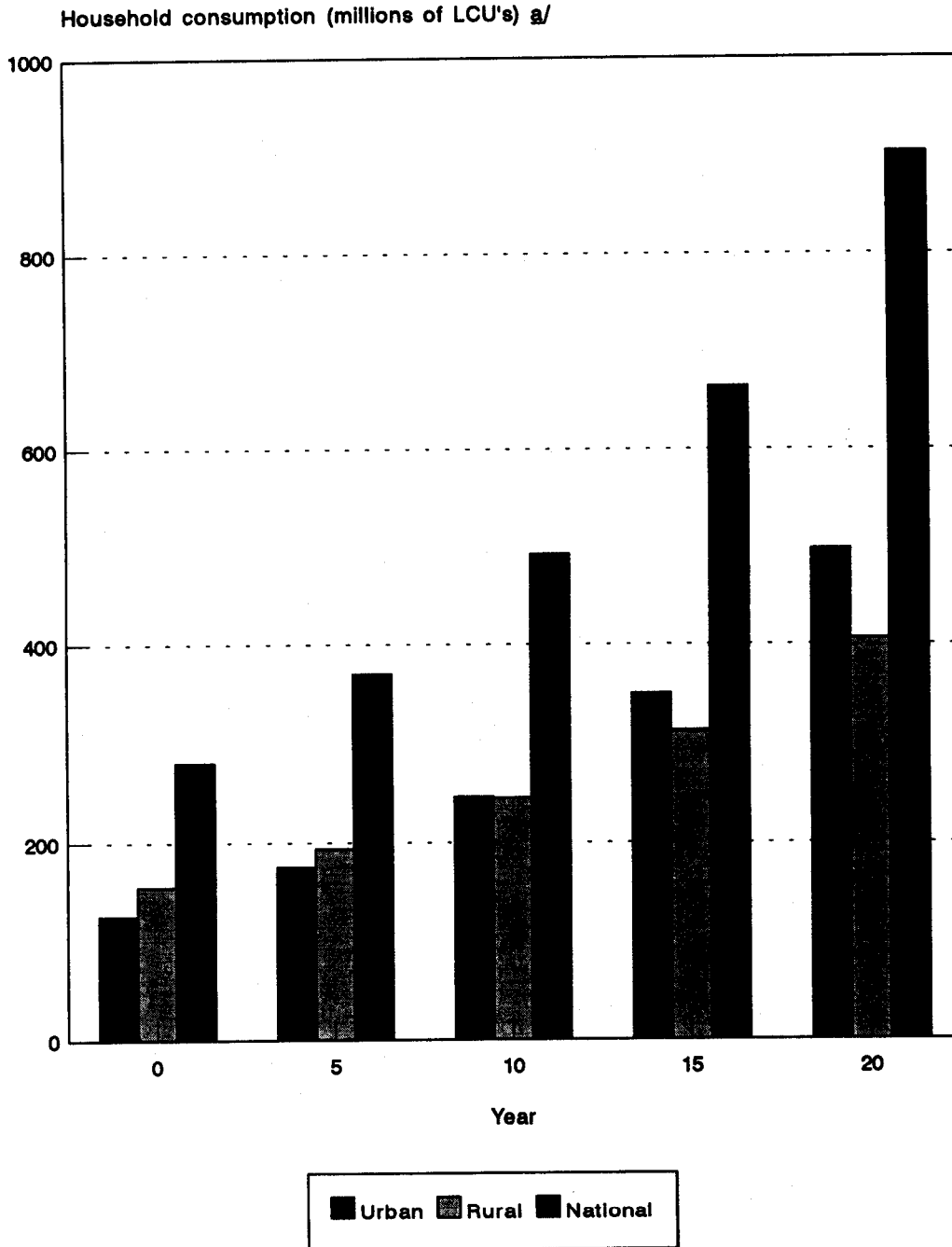
a/ Local currency units.

Table 94. Household consumption and savings aggregates, indicators of the pattern of household spending and rates of household consumption and savings change for the entire country

Indicators	Year				
	0	5	10	15	20
Household consumption and savings aggregates (millions of LCUs) a/					
Levels of household consumption and savings					
Total consumption	280.6	369.7	492.6	663.5	903.9
Food	164.6	217.2	288.5	385.6	520.0
Clothing	23.1	30.1	39.7	52.9	71.2
Other	92.8	122.3	164.3	224.9	312.7
Savings	45.6	59.7	78.8	105.0	141.2
Growth in household consumption and savings					
Total consumption		89.1	122.8	170.9	240.4
Food		52.6	71.2	97.0	134.4
Clothing		7.0	9.6	13.1	18.2
Other		29.4	41.9	60.6	87.7
Savings		14.1	19.1	26.1	36.2
Indicators of the household spending pattern					
Proportions of disposable household income spent or saved					
Food	0.50	0.50	0.50	0.50	0.49
Clothing	7.08	7.02	6.95	6.88	6.81
Other	0.28	0.28	0.28	0.29	0.29
Savings	0.13	0.13	0.13	0.13	0.13
Indicators of the urban-rural distribution of total household consumption and savings					
Proportions of total consumption					
Urban	0.44	0.47	0.50	0.52	0.55
Rural	0.55	0.52	0.49	0.47	0.44
Proportions of savings					
Urban	0.45	0.47	0.50	0.52	0.54
Rural	0.54	0.52	0.49	0.47	0.45
Rates of growth of household consumption and savings					
Total consumption		5.67	5.90	6.13	6.37
Food		5.70	5.83	5.97	6.16
Clothing		5.47	5.68	5.89	6.10
Other		5.66	6.07	6.48	6.80
Savings		5.54	5.72	5.89	6.10

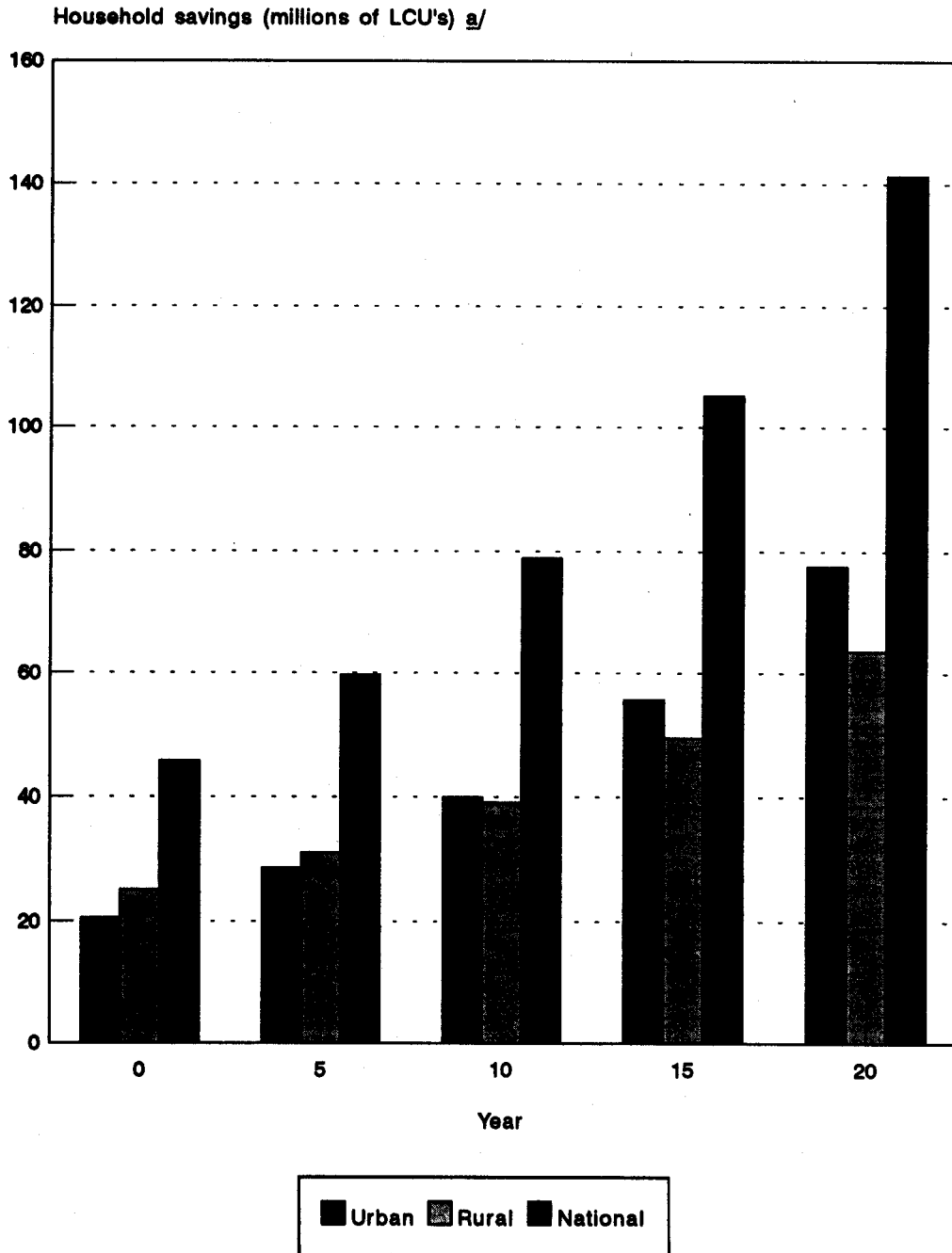
a/ Local currency units.

Figure XXIX. Total household consumption:
urban, rural and national



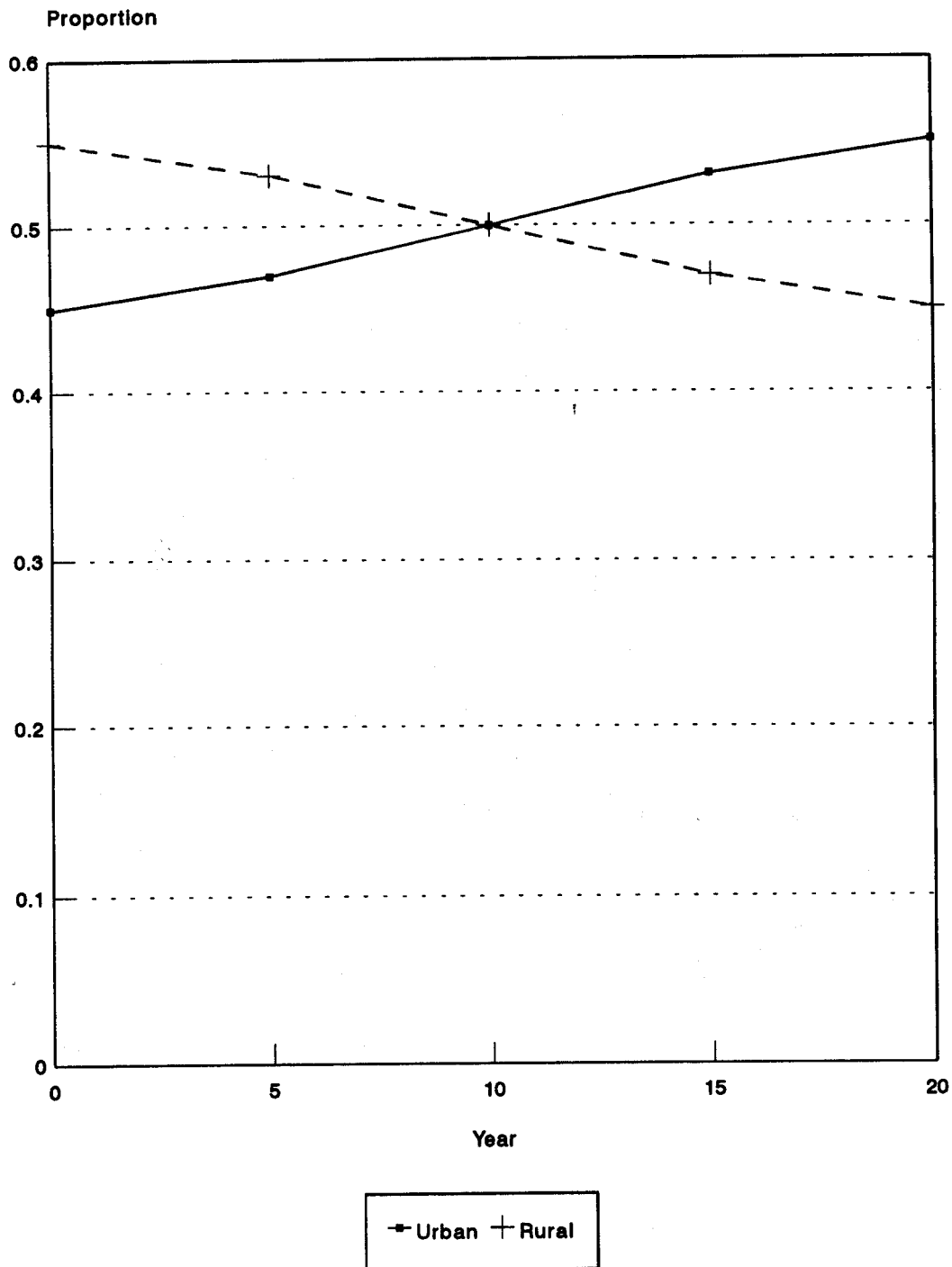
a/ Local currency units.

Figure XXX. Household savings: urban, rural and national



^{a/} Local currency units.

Figure XXXI. Proportions of household consumption that are urban and rural



the entire country. For the end of the interval 0-5, the proportion of household savings that is urban, 0.48, which is indicated in table 94, is obtained as:

$$0.48 = 28.6/59.7; \quad (27)$$

where 28.6 is the household savings in the urban areas and 59.7 is the household savings for the entire country in year 5 (shown, respectively, in tables 92 and 94).

The proportion of household savings that is rural at the end of the interval 0-5, 0.52, is calculated as a complement of the relevant proportion urban:

$$0.52 = 1 - 0.48; \quad (28)$$

where 0.48 is the proportion of household savings that is urban.

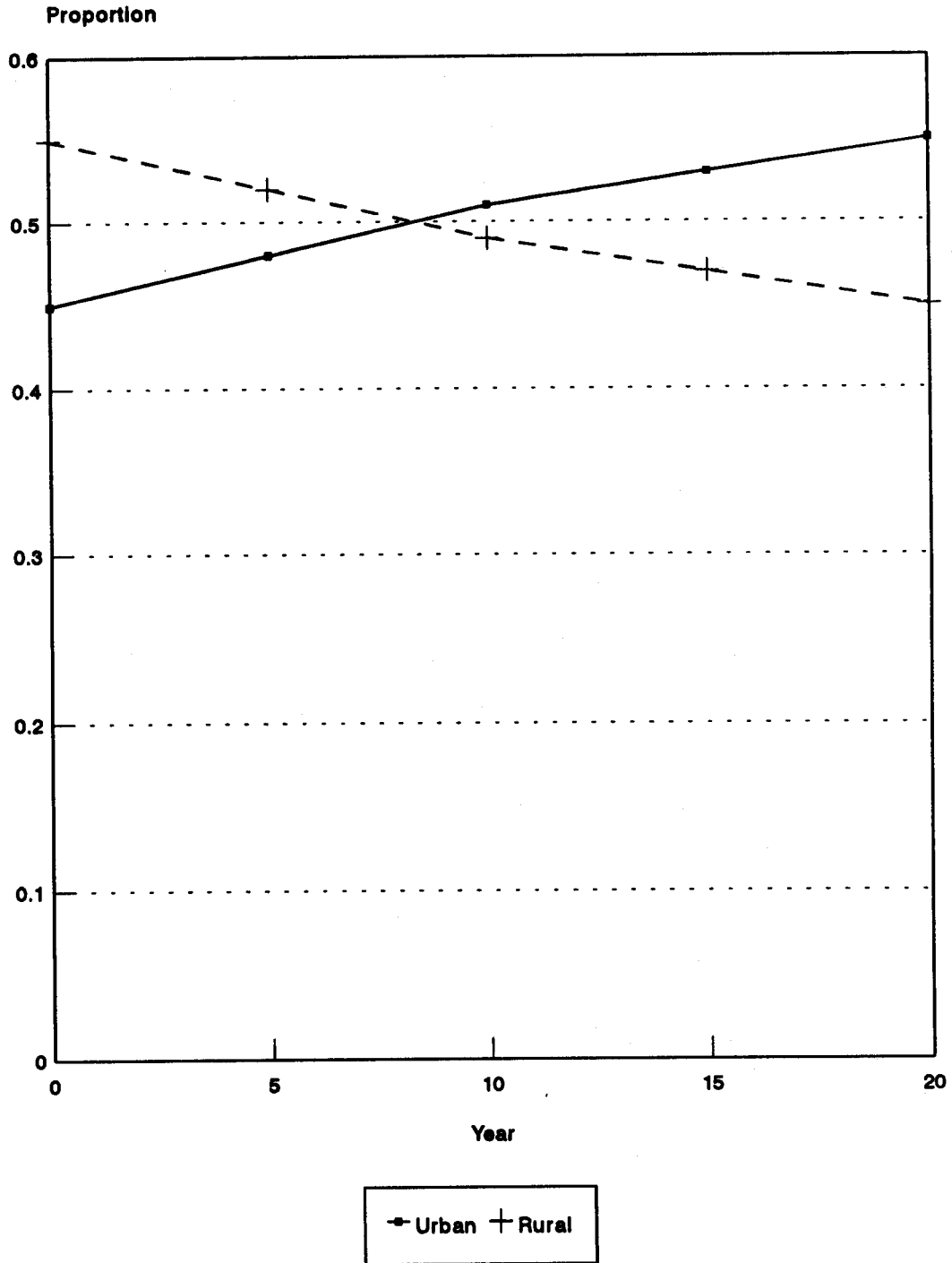
Proportions of household savings that are urban and rural over the projection period are shown in figure XXXII.

This completes the illustration of the procedures to project household consumption and savings using the linear expenditure systems and the extended linear expenditure system.

E. Summary

The present chapter has described a method for preparing household consumption and savings projections using variants of the linear expenditure system and the extended linear expenditure system that assume fixed commodity prices. The method can be employed to make national or urban-rural projections. In addition, the types of inputs required by the method have been described and the preparation of those inputs discussed. Lastly, an example of a national projection using expenditure functions of the linear expenditure system and an example of an urban-rural projection using expenditure functions of the extended linear expenditure system were described. A complete listing of the outputs that can be generated by the method is shown in box 26.

Figure XXXII. Proportions of household savings that are urban and rural



Box 26

Outputs of the method for making household consumption and savings projections using the linear expenditure system or the extended linear expenditure system

1. Levels of per capita household consumption by commodity group and per household savings (national or urban, rural and national)
2. Levels of household consumption by commodity group and levels of household savings (national or urban, rural and national)
3. Household consumption and savings aggregates (national or urban, rural and national)

Levels of household consumption and savings:

Total consumption

Consumption by broad commodity groups (e.g., food, clothing, other)

Savings

Growth in household consumption and savings:

Total

Consumption by broad commodity groups

Savings

4. Indicators of the spending pattern of households (national or urban, rural and national)

Proportions of disposable household income spent or saved:

Consumption by broad commodity groups

Savings

(continued)

Box 26 (continued)

5. Indicators of the urban-rural distribution of total household consumption and savings (national only, if urban and rural household consumption and savings are being projected)

Proportions of total household consumption:

Urban
Rural

Proportions of household savings:

Urban
Rural

6. Rates of growth of household consumption and savings (national or urban, rural and national)

Total consumption

Consumption by commodity groups

Savings

F. Notation and equations

1. Indices, variables and special symbols

(a) List of indices

$g = 1, \dots, G$	are commodity groups
$h = 1, \dots, H$	are broad commodity groups
j	is the cluster of households
$k = 1, 2$	are urban and rural locations
t	is the year of the projection period
t'	is the calendar year

(b) List of variables

ASVR($t+5$)	is the average household savings ratio at the end of the interval
DHI($t+5$)	is the disposable household income at the end of the interval
EGRHC	is the average annual exponential growth rate of total household consumption for the interval
EGRHC(h)	is the average annual exponential growth rate of household consumption in broad commodity group h for the interval
EGRHSV	is the average annual exponential growth rate of household savings for the interval
GGRHC	is the average annual geometric growth rate of total household consumption for the interval
GGRHC(h)	is the average annual geometric growth rate of household consumption in broad commodity group h for the interval
GGRHSV	is the average annual geometric growth rate of household savings for the interval
HC($g, t+5$)	is the level of household consumption of goods and services in commodity group g at the end of the interval

HC(h,t+5)	is the level of household consumption of goods and services in broad commodity group h at the end of the interval
HC(k,t+5)	is the total household consumption in location k at the end of the interval
HC(t+5)	is the level of total household consumption at the end of the interval
HCG	is the growth of total household consumption during the interval
HCG(h)	is the growth of household consumption in broad commodity group h over the interval
HSV(k,t+5)	is the level of household savings in location k at the end of the interval
HSV(t+5)	is the level of household savings at the end of the interval
HSVG	is the growth of household savings during the interval
PCC(g,j)	is the mean level of per capita household consumption of goods and services in commodity group g in household cluster j
PCC(g,t')	is the level of per capita consumption of goods and services in commodity group g in year t'
PCC(g,t+5)	is the level of per capita household consumption of goods and services in commodity group g at the end of the interval
PCC(t+5)	is the level of per capita total household consumption at the end of the interval
PCDHI(j)	is the mean level of per capita disposable household income in household cluster j
PCDHI(t')	is the level of per capita disposable household income in year t'
PCDHI(t+5)	is the level of per capita disposable household income at the end of the interval
PCSV(t+5)	is the level of per capita household savings at the end of the interval
PCTHE(j)	is the mean level of per capita total household expenditure in household cluster j

PCTHE(t')	is the level of per capita total household expenditure in year t'
PCTHE($t+5$)	is the level of per capita total household expenditure at the end of the interval
POP($t+5$)	is the population size at the end of the interval
PRDHIC($h, t+5$)	is the proportion of disposable household income spent on consumption of goods and services in broad commodity group h at the end of the interval
PRDHISV($t+5$)	is the proportion of disposable household income saved at the end of the interval
PRHCRUR($t+5$)	is the proportion of total household consumption that is rural at the end of the interval
PRHCURB($t+5$)	is the proportion of total household consumption that is urban at the end of the interval
PRHSVRUR($t+5$)	is the proportion of household savings that is rural at the end of the interval
PRHSVURB($t+5$)	is the proportion of household savings that is urban at the end of the interval

(c) List of special symbols

$a(g)$	is the intercept coefficient of the expenditure function for commodity group g in the linear expenditure system or the extended linear expenditure system
$a^*(g)$	is the estimate of the intercept coefficient of the expenditure function for commodity group g in the linear expenditure system or the extended linear expenditure system
$b(g)$	is the partial coefficient of per capita total household expenditure in the expenditure function for commodity group g in the linear expenditure system or the partial coefficient of per capita disposable household income in the expenditure function for the same commodity group in the extended linear expenditure system
$b^*(g)$	is the estimate of the partial coefficient of per capita total household expenditure in the expenditure function for commodity group g in the linear expenditure system or the partial coefficient of per capita disposable household income in the expenditure

functions for the same commodity group in the extended linear expenditure system

G is the number of commodity groups

H is the number of broad commodity groups

T is a transformation indicating the way household consumption levels by commodity groups are aggregated to obtain household consumption levels by broad commodity groups

$u(g, j)$ is the random disturbance term for commodity group g in household cluster j

2. Equations

A. The technique

National level

(a) Procedure based on the linear expenditure system

(i) Expenditure functions

$$PCC(g, t') = a(g) + b(g) \cdot PCTHE(t'); \quad (1)$$

$$g = 1, \dots, G$$

(ii) Levels of per capita household consumption and savings

a. Level of per capita total household expenditure

$$PCTHE(t+5) = PCDHI(t+5) \cdot [1 - ASVR(t+5)]; \quad (2)$$

b. Levels of per capita household consumption by commodity group

$$PCC(g, t+5) = a^*(g) + b^*(g) \cdot PCTHE(t+5); \quad (3)$$

$$g = 1, \dots, G$$

c. Level of per capita household savings

$$PCSV(t+5) = PCDHI(t+5) - PCTHE(t+5); \quad (4)$$

(iii) Levels of household consumption by commodity group and levels of household savings

a. Household consumption by commodity group

$$\begin{aligned} \text{HC}(g, t+5) &= \text{PCC}(g, t+5) \cdot \text{POP}(t+5); & (5) \\ g &= 1, \dots, G \end{aligned}$$

b. Household savings

$$\text{HSV}(t+5) = \text{PCSV}(t+5) \cdot \text{POP}(t+5); \quad (6)$$

(iv) Other results

a. Household consumption and savings aggregates

i. Total household consumption

$$\text{HC}(t+5) = \sum_{g=1}^G \text{HC}(g, t+5); \quad (7)$$

ii. Household consumption by broad commodity groups

$$\begin{aligned} \text{HC}(h, t+5) &= T [\text{HC}(g, t+5)]; & (8) \\ h &= 1, \dots, H \end{aligned}$$

iii. Growth in total household consumption

$$\text{HCG} = \text{HC}(t+5) - \text{HC}(t); \quad (9)$$

iv. Growth of household consumption by broad commodity groups

$$\begin{aligned} \text{HCG}(h) &= \text{HC}(h, t+5) - \text{HC}(h, t); & (10) \\ h &= 1, \dots, H \end{aligned}$$

v. Growth in household savings

$$\text{HSVG} = \text{HSV}(t+5) - \text{HSV}(t); \quad (11)$$

b. Indicators of the spending pattern of households

i. Disposable household income

$$\text{DHI}(t+5) = \text{PCDHI}(t+5) \cdot \text{POP}(t+5); \quad (12)$$

ii. Proportions of disposable household income spent on goods and services in broad commodity groups

$$\text{PRDHIC}(h,t+5) = \text{HC}(h,t+5) / \text{DHI}(t+5); \quad (13)$$

$$h = 1, \dots, H$$

iii. Proportion of disposable household income saved

$$\text{PRDHISV}(t+5) = \text{HSV}(t+5) / \text{DHI}(t+5); \quad (14)$$

c. Rates of growth of household consumption and savings

i. Rate of growth of total household consumption

Geometric growth rate

$$\text{GGRHC} = [(\text{HC}(t+5)/\text{HC}(t))^{1/5} - 1] \cdot 100; \quad (15)$$

Exponential growth rate

$$\text{EGRHC} = [\ln (\text{HC}(t+5)/\text{HC}(t)) / 5] \cdot 100; \quad (16)$$

ii. Rates of growth of household consumption by broad commodity groups

Geometric growth rate

$$\text{GGRHC}(h) = [(\text{HC}(h,t+5)/\text{HC}(h,t))^{1/5} - 1] \cdot 100; \quad (17)$$

$$h = 1, \dots, H$$

Exponential growth rates

$$\begin{aligned} \text{EGRHC}(h) &= [\ln (\text{HC}(h,t+5)/\text{HC}(h,t)) / 5] \cdot 100; \\ h &= 1, \dots, H \end{aligned} \quad (18)$$

iii. Rate of growth of household savings

Geometric growth rate

$$\text{GGRHSV} = [(\text{HSV}(t+5)/\text{HSV}(t))^{1/5} - 1] \cdot 100; \quad (19)$$

Exponential growth rate

$$\text{EGRHSV} = [\ln (\text{HSV}(t+5)/\text{HSV}(t)) / 5] \cdot 100; \quad (20)$$

(b) Procedure based on the extended linear expenditure system

(i) Expenditure functions

$$\begin{aligned} \text{PCC}(g,t') &= a(g) + b(g) \cdot \text{PCDHI}(t'); \\ g &= 1, \dots, G \end{aligned} \quad (21)$$

(ii) Levels of per capita household consumption and savings

a. Levels of per capita household consumption by commodity group

$$\begin{aligned} \text{PCC}(g,t+5) &= a^*(g) + b^*(g) \cdot \text{PCDHI}(t+5); \\ g &= 1, \dots, G \end{aligned} \quad (22)$$

b. Level of per capita total household consumption

$$\text{PCC}(t+5) = \sum_{g=1}^G \text{PCC}(g,t+5); \quad (23)$$

c. Level of per capita household savings

$$\text{PCSV}(t+5) = \text{PCDHI}(t+5) - \text{PCC}(t+5); \quad (24)$$

(iii) Levels of household consumption and savings and other results

2. Urban-rural level

(a) Procedure based on the linear expenditure system

(i) Expenditure functions

(ii) Levels of per capita household consumption and savings

(iii) Levels of household consumption and savings

(iv) Other results

a. Proportions of total household consumption that are urban and rural

$$\text{PRHCURB}(t+5) = \text{HC}(1, t+5) / \text{HC}(t+5); \quad (25)$$

$$\text{PRHCRUR}(t+5) = 1 - \text{PRHCURB}(t+5); \quad (26)$$

b. Proportions of household savings that are urban and rural

$$\text{PRHSVURB}(t+5) = \text{HSV}(1, t+5) / \text{HSV}(t+5); \quad (27)$$

$$\text{PRHSVRUR}(t+5) = 1 - \text{PRHSVURB}(t+5); \quad (28)$$

(b) Procedures based on the extended linear expenditure system

(i) Expenditure function

(ii) Levels of per capita household consumption and savings

(iii) Levels of household consumption and savings and other results

B. The inputs

1. Types of inputs required

2. Preparation of inputs

(a) Assumptions on the average household savings ratio

(b) Estimates of expenditure functions of the alternative expenditure systems

(i) Cross-section data

(ii) Procedures to estimate alternative expenditure systems

a. National level

i. Linear expenditure system

$$PCC(g, j) = a(g) + b(g) \cdot PCTHE(j) + u(g, j); \quad (29)$$

$$g = 1, \dots, G$$

ii. Extended linear expenditure system

$$PCC(g, j) = a(g) + b(g) \cdot PCDHI(j) + u(g, j); \quad (30)$$

$$g = 1, \dots, G$$

b. Urban-rural level

i. Linear expenditure system

ii. Extended linear expenditure system

Notes

1/ Throughout this chapter, "household consumption" and "household savings" refer to the value of household consumption and savings measured in constant prices.

2/ For projections carried out by means other than those using LES and ELES and employing the assumption of fixed relative prices, see, for example, Mason and others (1987a).

3/ Much of this section is similar to section B.2.(a)(iv) in chapter X. The reader who is familiar with the content of that section may wish to skip the current section.

4/ The proportion of disposable household income saved, which is obtained using the procedure based on the linear expenditure system, equals the assumed average household savings ratio.

5/ This description of the procedures to estimate alternative demand systems will use the cluster of households as the unit of observation instead of the calendar year. Illustrative applications of the procedures to be discussed below will use cross-sectional data pertaining to the household clusters.

6/ Much of this section is similar to section D.1.(c) in chapter X. The reader who is familiar with the content of that section may wish to skip the current section.

7/ The figures presented in the text have been rounded to the nearest decimal point. Therefore the components may not add up to the totals.

Annex I

LINEAR EXPENDITURE SYSTEM

The linear expenditure system (LES) is the best known of the demand systems rooted in neoclassical economic theory. It has been estimated using a variety of data ^{a/} and has been used as part of analytical and planning models.^{b/} This system, which assumes that household decisions are made on the basis of per capita resources, postulates that the determinants of the allocation of the total household expenditure are the level of that expenditure and relative prices. Other factors that may have an influence on household allocation decisions, such as location of residence and various characteristics of the household, are not part of the demand system.

The linear expenditure system can be estimated under assumptions of variable or constant relative prices. If suitable data, such as time series information on the levels of per capita consumption by commodity category and per capita total expenditure are available from national accounts, in both current and constant prices, the parameters of the expenditure functions of this system can be estimated under the assumption of variable relative prices. If the available data are more limited, such as cross-sectional survey information on the levels of per capita household consumption by commodity group and per capita total household expenditure, the expenditure functions must be estimated by assuming that the relative prices of the various commodities are fixed.

This annex will initially present the standard specification of LES, which assumes variable prices. Then, it will show how this specification can be transformed into one that assumes constant relative prices. Throughout this discussion, the calendar year will be used as the unit observation.

A. Linear expenditure system under variable prices

The linear expenditure system under variable prices consists of a set of linear expenditure functions in per capita terms that postulate that the amount of household resources spent on each commodity or group of commodities is a function of per capita total household expenditure and the prices of those commodities. The functions are as follows:

$$PCC(g,t') = c(g) \cdot PR(g,t') + \tag{1}$$

$$b(g) \cdot [PCTHE(t') - \sum_{g'=1}^G c(g') \cdot PR(g',t')];$$
$$g = 1, \dots, G,$$

where:

$g = g' = 1, \dots, G$ are commodity groups,

G is the number of commodity groups,

t'	is the calendar year,
$PCC(g, t')$	is the level of per capita consumption of goods and services in commodity group g in year t' ,
$PR(g, t')$	is the composite price of goods and services in commodity group g in year t' ,
$PCTHE(t')$	is the level of per capita total household expenditure in year t' ,
$b(g)$	is the coefficient representing the marginal budget share for goods and services in commodity group g , and
$c(g)$	is the coefficient for commodity group g indicating the level of committed consumption of goods and services of commodity group g .

The levels of committed consumption, $c(g)$'s, which are also referred to as levels of basic needs or subsistence quantities, are hypothesized to be positive. The value of the committed consumption of various goods and services, $\sum_{g'=1}^G c(g') \cdot PR(g', t')$, is referred to as total committed or subsistence expenditure. The difference between the total expenditure and the total committed expenditure, $PCTHE(t') - \sum_{g'=1}^G c(g') \cdot PR(g', t')$, may be thought of as uncommitted or "supernumerary" expenditure.

The marginal budget shares, $b(g)$'s, are marginal propensities to consume out of total expenditure, which add up to unity, i.e., $\sum_{g=1}^G b(g) = 1$. They indicate how the supernumerary expenditure is allocated among the goods and services in the various commodity groups.

B. Linear expenditure system under constant relative prices

If it is assumed that prices are relatively fixed, then the expenditure functions indicated in equation (1) can be rewritten as follows:

$$PCC(g, t') = c(g) \cdot PR(g) + b(g) \cdot [PCTHE(t') - \sum_{g'=1}^G c(g') \cdot PR(g')]; \quad (2)$$

$$g = 1, \dots, G,$$

where:

$PR(g)$	is the constant composite price of goods and services in commodity group g .
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Further, the expenditure functions shown in equation (2) can be rewritten in order to obtain the following set of functions:

$$PCC(g, t') = c(g) \cdot PR(g) + \quad (3)$$

$$b(g) \cdot PCTHE(t') - b(g) \cdot \sum_{g'=1}^G c(g') \cdot PR(g');$$

$$g = 1, \dots, G.$$

Moreover, the functions shown in equation (3) can be rearranged in order to obtain the following set of expenditure functions expressing per capita consumption by commodity group in terms of per capita total expenditure:

$$PCC(g, t') = a(g) + b(g) \cdot PCTHE(t'); \quad (4)$$

$$g = 1, \dots, G,$$

where:

$$a(g) = c(g) \cdot PR(g) - b(g) \cdot \sum_{g'=1}^G c(g') \cdot PR(g'); \quad (5)$$

The expenditure functions shown in equation (4) are the functions of the linear expenditure system under fixed relative prices, which are indicated in equation (1) in chapter XI. Equation (5) shows the relationship between the intercept coefficients of LES expenditure functions under constant prices and the coefficients and variables of the standard specification of LES expenditure functions under this assumption -- $c(g)$'s, $PR(g)$'s and $b(g)$'s.

C. Notation and equations

1. Indices, variables and special symbols

(a) List of indices

$g = g' = 1, \dots, G$ are commodity groups

t' is the calendar year

(b) List of variables

$PCC(g, t')$ is the level of per capita consumption of goods and services in commodity group g in year t'

$PCTHE(t')$ is the level of per capita total household expenditure in year t'

$PR(g)$ is the constant composite price of goods and services in commodity group g

$PR(g, t')$ is the composite price of goods and services in commodity group g in year t'

(c) List of special symbols

- b(g) is the coefficient representing the marginal budget share for goods and services in commodity group g
- c(g) is the coefficient for commodity group g indicating the level of committed consumption of goods and services of commodity group g
- G is the number of commodity groups

2. Equations

A. Linear expenditure system under variable prices

$$PCC(g,t') = c(g) \cdot PR(g,t') + \quad (1)$$

$$b(g) \cdot [PCTHE(t') - \sum_{g'=1}^G c(g') \cdot PR(g',t')];$$

$$g = 1, \dots, G$$

B. Linear expenditure system under constant prices

$$PCC(g,t') = c(g) \cdot PR(g) + b(g) \cdot [PCTHE(t') - \sum_{g'=1}^G c(g') \cdot PR(g')]; \quad (2)$$

$$g = 1, \dots, G$$

$$PCC(g,t') = c(g) \cdot PR(g) + \quad (3)$$

$$b(g) \cdot PCTHE(t') - b(g) \cdot \sum_{g'=1}^G c(g') \cdot PR(g');$$

$$g = 1, \dots, G$$

$$PCC(g,t') = a(g) + b(g) \cdot PCTHE(t'); \quad (4)$$

$$g = 1, \dots, G$$

where:

$$a(g) = c(g) \cdot PR(g) - b(g) \cdot \sum_{g'=1}^G c(g') \cdot PR(g'); \quad (5)$$

Notes

a/ Data used to estimate this demand system include time series observations on consumption and total expenditure in constant and current prices, as well as cross-section information on consumption and total expenditure in local prices.

b/ Examples of analytical and planning models embodying the linear expenditure system and the Kelly-Williamson-Cheetham model (Kelly and others, 1972) and the Indian planning model (Government of India, 1981).

Annex II

EXTENDED LINEAR EXPENDITURE SYSTEM

The extended linear expenditure system (ELES) is a variant of the linear expenditure system (LES) (annex I). This system has been estimated using data from a number of countries, but unlike LES it has not often been used in the context of analytic or planning models. Similar to LES, it assumes that household decisions are made on a per capita basis and postulates that the allocation of the disposable household income is a function of the level of that income and commodity prices. Other factors that may have an effect on the household allocation decisions are not part of this demand system.^{2/}

Like the linear expenditure system, the extended linear expenditure system can be estimated under assumptions of variable or constant relative prices. If appropriate information is available in current and constant prices from national accounts, estimates of the parameters of the expenditure functions of this system can be obtained under the assumption of variable relative prices. If the requisite information does not contain data on price variations, the expenditure functions must be estimated by assuming that the relative prices of the various commodities are fixed.

This annex first describes the standard specification of ELES, which assumes variable prices. Then, using the assumption of constant prices, it will show how this specification can be transformed into one that is based on such an assumption. In this discussion, the calendar year will be used as the unit observation.

A. Extended linear expenditure system under variable prices

The extended linear expenditure system under constant relative prices consists of a set of linear expenditure functions in per capita terms that postulate that the amount of household resources spent on each commodity or group of commodities is a function of per capita disposable household income and the relative prices of those commodities. The functions are as follows:

$$PCC(g,t') = c(g) \cdot PR(g,t') + \tag{1}$$

$$b(g) \cdot [PCDHI(t') - \sum_{g'=1}^G c(g') \cdot PR(g',t')],$$

$$g = 1, \dots, G,$$

where:

$g - g' = 1, \dots, G$ are commodity groups,

G is the number of commodity groups,

t' is the calendar year,

PCC(g,t')	is the level of per capita consumption of goods and services in commodity group g in year t',
PR(g,t')	is the composite price of goods and services in commodity group g in year t',
PCDHI(t')	is the level of per capita disposable household income in year t',
b(g)	is the coefficient representing the marginal income share for goods and services in commodity group g, and
c(g)	is the coefficient for commodity group g indicating the level of committed consumption of goods and services of commodity group g.

As in the case of the linear expenditure system, the levels of committed consumption, c(g)'s, which are also referred to as levels of basic needs or subsistence quantities, are assumed to be positive. The value of the committed consumption of various goods and services, $\sum_{g=1}^G c(g) \cdot PR(g,t')$, is referred to as total committed or subsistence expenditure. The difference between the disposable household income and the total committed expenditure, $PCDHI(t') - \sum_{g=1}^G c(g) \cdot PR(g,t')$, may be thought of as uncommitted or "supernumerary" income.

The marginal income shares, b(g)'s, are marginal propensities to consume out of disposable income. They indicate how the supernumerary income is allocated among the goods and services in the various commodity groups. Marginal propensities to consume add up to the aggregate marginal propensity to consume. The complement of this aggregate marginal propensity to consume is the marginal propensity to save.

B. Extended linear expenditure system under constant prices

If it is assumed that prices are fixed, then the expenditure functions indicated in equation (1) can be rewritten as follows:

$$PCC(g,t') = c(g) \cdot PR(g) + b(g) \cdot [PCDHI(t') - \sum_{g'=1}^G c(g') \cdot PR(g')]; \quad (2)$$

$$g = 1, \dots, G,$$

where:

PR(g) is the constant composite price of goods and services in commodity group g.

Next, the expenditure functions shown in equation (2) can be rewritten in order to obtain the following set of functions:

$$PCC(g, t') = c(g) \cdot PR(g) + \quad (3)$$

$$b(g) \cdot PCDHI(t') - b(g) \cdot \sum_{g'=1}^G c(g') \cdot PR(g');$$

$$g = 1, \dots, G.$$

In addition, the functions shown in equation (3) can be rearranged in order to arrive at the following set of expenditure functions expressing per capita consumption by commodity group in terms of per capita disposable household income:

$$PCC(g, t') = a(g) + b(g) \cdot PCDHI(t'); \quad (4)$$

$$g = 1, \dots, G,$$

where:

$$a(g) = c(g) \cdot PR(g) - b(g) \cdot \sum_{g'=1}^G c(g') \cdot PR(g'); \quad (5)$$

The expenditure functions indicated in equation (4) are the functions of the extended linear expenditure system under fixed prices, which are shown in equation (21) in chapter XI. Equation (5) shows the relationship between the intercept coefficients of ELES expenditure functions under constant prices and the coefficients and variables of the standard specification of ELES expenditure functions under that assumption -- $c(g)$'s, $PR(g)$'s and $b(g)$'s.

C. Notation and equations

1. Indices, variables and special symbols

(a) List of indices

$g = g' = 1, \dots, G$ are commodity groups

t' is the calendar year

(b) List of variables

$PCC(g, t')$ is the level of per capita consumption of goods and services in commodity group g in year t'

$PCDHI(t')$ is the level of per capita disposable household income in year t'

$PR(g)$ is the constant composite price of goods and services in commodity group g

$PR(g,t')$ is the composite price of goods and services in commodity group g in year t'

(c) List of special symbols

$b(g)$ is the coefficient representing the marginal income share for goods and services in commodity group g

$c(g)$ is the coefficient for commodity group g indicating the level of committed consumption of goods and services of commodity group g

G is the number of commodity groups

2. Equations

A. Extended linear expenditure system under variable prices

$$PCC(g,t') = c(g) \cdot PR(g,t') + \tag{1}$$

$$b(g) \cdot [PCDHI(t') - \sum_{g'=1}^G c(g') \cdot PR(g',t')],$$

$$g = 1, \dots, G$$

B. Extended linear expenditure system under constant prices

$$PCC(g,t') = c(g) \cdot PR(g) + \tag{2}$$

$$b(g) \cdot [PCDHI(t') - \sum_{g'=1}^G c(g') \cdot PR(g')],$$

$$g = 1, \dots, G$$

$$PCC(g,t') = c(g) \cdot PR(g) + \tag{3}$$

$$b(g) \cdot PCDHI(t') - b(g) \cdot \sum_{g'=1}^G c(g') \cdot PR(g');$$

$$g = 1, \dots, G$$

$$\begin{aligned} \text{PCC}(g, t') &= a(g) + b(g) \cdot \text{PCDHI}(t'); \\ g &= 1, \dots, G, \end{aligned} \tag{4}$$

where:

$$a(g) = c(g) \cdot \text{PR}(g) - b(g) \cdot \sum_{g'=1}^G c(g') \cdot \text{PR}(g'); \tag{5}$$

Notes

a/ The extended linear expenditure system is a variant of the linear expenditure system. This annex is similar to annex I. The reader who is familiar with annex I may, while reading the present annex, focus on features unique to the extended linear expenditure system.

Annex III

PROCEDURES TO CALIBRATE THE LINEAR EXPENDITURE SYSTEM AND THE EXTENDED LINEAR EXPENDITURE SYSTEM

Estimated expenditure functions may be adjusted so that they will accurately yield levels of per capita household consumption for a given historical year or time period using as inputs the observations on the explanatory variables for that year or period.^{2/} These adjustments, which are normally referred to as calibration, may be employed, for example, where household consumption and savings projections need to be consistent with the corresponding data coming from the national accounts or a social accounting matrix for a given year or time period.

Calibrating expenditure functions may involve adjustments in estimates of the intercept coefficients of the functions, in estimates of the partial coefficients or in both. Since adjustments in the intercept coefficients are more straightforward than those in the partial coefficients, calibration may often be restricted to intercepts. Moreover, in the case of expenditure functions of the linear expenditure system or the extended linear expenditure system, one may wish to restrict calibration to estimates of the intercept coefficient, so that the adding-up property that those functions possess is retained. Therefore, this annex will describe how the intercept coefficients of the expenditure functions of those two linear demand systems can be calibrated. It will first describe calibration procedures and then selectively illustrate their application.

A. Procedures

The principles for adjusting the intercept coefficients of expenditure functions are the same for the linear expenditure system as for the extended linear expenditure system. The steps make use of the estimates of the partial coefficients of the functions, as well as observations on the levels of per capita household consumption by commodity groups and the observation on the explanatory variable, which are for the selected year or time period. Depending on the demand system used, the explanatory variable may be per capita total household expenditure or per capita disposable household income. The actual steps involved in adjusting the intercepts vary, however, depending on the demand system involved, as well as on whether the expenditure functions are for the entire country or for urban and rural areas.

1. National level

This section will describe procedures that apply to expenditure functions estimated for the entire country. It will first discuss adjustments to the functions of the linear expenditure system and then to those of the extended linear expenditure system. Procedures applicable to functions estimated for urban and rural areas will be explained in a subsequent section.

(a) Linear expenditure system

The procedure used to obtain adjusted intercepts of expenditure functions of the linear expenditure system using the relevant observations for a given year is as follows:

$$[a^*(g)]' = PCC(g, t') - b^*(g) \cdot PCTHE(t'); \quad (1)$$

$$g = 1, \dots, G,$$

where:

- $g = 1, \dots, G$ are commodity groups,
- G is the number of commodity groups,
- t' is the given calendar year,
- $PCC(g, t')$ is the observed mean level of per capita household consumption in commodity group g in year t' ,
- $PCTHE(t')$ is the observed mean level of per capita total household expenditure in year t' ,
- $[a^*(g)]'$ is the adjusted intercept coefficient of the expenditure function for commodity group g in the linear expenditure system, and
- $b^*(g)$ is the estimate of the partial coefficient of per capita total household expenditure in the expenditure function for commodity group g in the linear expenditure system.

The expression shown in equation (1) can also be used to adjust the intercept coefficients employing data for a few or several years rather than a single year. The observed levels of per capita consumption by commodity group and per capita total household expenditure for the years in question would be the mean values of the observations on those variables for those years centred on one particular year, t' .

(b) Extended linear expenditure system

The procedure to calculate adjusted intercept coefficients of expenditure functions of the extended linear expenditure system is as follows:

$$[a^*(g)]' = PCC(g, t') - b^*(g) \cdot PCDHI(t'); \quad (2)$$

$$g = 1, \dots, G,$$

where:

- PCDHI(t') is the observed mean level of per capita disposable household income in year t' ,
- $[a^*(g)]'$ is the adjusted intercept coefficient of the expenditure function for commodity group g in the extended linear expenditure system, and
- PCC(g, t') is the observed mean level of per capita household consumption in commodity group g in year t' ,
- $b^*(g)$ is the estimate of the partial coefficient of per capita disposable household income in the expenditure function for commodity group g in the extended linear expenditure system.

The intercept coefficients of the expenditure functions can be adjusted with data for a few or several years, rather than a single year, by using the expression shown in equation (2). In that instance, the relevant observations would be the mean values of the observations.

1. Urban-rural level

After estimating the expenditure functions for urban and rural areas, the intercept coefficients of those functions can be adjusted. To do so, it is necessary to use the estimates of the partial coefficients of the functions along with observations on the levels of per capita household consumption by commodity group, as well as observations on the relevant explanatory variable for a given year or time period.

(a) Linear expenditure system

The procedure for calibrating expenditure functions of the linear expenditure system for urban and rural areas would include steps that are urban-rural equivalents of the steps described above using equation (1).

(b) Extended linear expenditure system

The procedure for calibrating expenditure functions of the extended linear expenditure system for urban and rural areas would be an urban-rural counterpart of the procedure described above using equation (2).

B. Illustrative examples of calibration

The examples presented below will illustrate selected procedures to calibrate functions of alternative demand systems for the entire country and urban and rural areas. They will show how to calibrate the functions that were employed in chapter XI in order to illustrate their use in preparing household consumption and savings projections. The first example will show how to derive

adjusted intercept coefficients for the expenditure functions of the linear expenditure system for the entire country. The second example will indicate the way to adjust intercepts for expenditure functions of the extended linear expenditure system for urban and rural areas.

1. National level

This example will illustrate a procedure to calibrate the estimates of the expenditure functions of a linear expenditure system as shown in table 72 (chapter XI) using, among other things, the estimated partial coefficients of those functions. The hypothetical mean values of the levels of per capita household consumption will be used, along with hypothetical mean values of per capita total household expenditure. It will be assumed that those values refer to a year that precedes the initial year of the projection (year 0) by two years and is therefore referred to as year -2.

Table 95 illustrates the calculation of the adjusted intercepts of the functions in question. The adjusted intercept coefficient (column 5) for each commodity group is obtained as the difference between the observed level of per capita household consumption in year -2 (column 4) and the product of the estimated coefficient of per capita total household expenditure for the commodity group in question (column 2) and the level of per capita total household expenditure in year -2 (column 3).

Thus, the adjusted intercept in the function for food, 1.60775, is obtained as follows:

$$1.60775 = 15.39 - (0.52404) (26.30); \quad (1)$$

where 15.39 is the level of per capita household consumption of food in year -2, while 0.52404 is the estimate of the total expenditure coefficient for food and 26.30 is the mean value of the per capita total household expenditure in year -2.

2. Urban-rural level

This example shows how to calibrate estimates of expenditure functions of the extended linear expenditure system for urban and rural areas, which were shown in tables 77 and 78 (chapter XI). To derive adjusted intercepts for these functions, the estimates of the partial coefficients of those functions will be used along with the hypothetical values of per capita household consumption by commodity group and hypothetical values of per capita disposable household income for urban and rural areas.

Tables 96 and 97 illustrate calculations of the adjusted intercepts for the functions in question. For either location the adjusted intercept coefficient (column 5) for each commodity group is obtained as the difference between the mean level of per capita household consumption for the group for year -2 (column 4) and a product. The product is obtained by multiplying the estimated disposable income coefficient for the commodity group in question (column 2) by the mean value of per capita disposable household income in year -2 (column 3).

Table 95. Computing adjusted intercept coefficients for expenditure functions of the linear expenditure system for the entire country using data for a selected year

Commodity group	Total expenditure coefficient a/	Per capita total expenditure in year -2 (in LCUs) c/	Per capita household consumption in year -2	Adjusted intercept coefficient b/
(1)	(2)	(3)	(4)	(5)
Food	0.52404	26.30	15.39	1.60774
Clothing	0.07371	26.30	2.18	0.24142
Housing	0.05472	26.30	0.98	-0.45913
Fuel and light	0.04882	26.30	2.24	0.95603
Durables	0.13690	26.30	1.70	-1.90047
Transportation	0.01033	26.30	0.40	0.12832
Personal care	0.03095	26.30	0.83	0.01601
Recreation	0.06829	26.30	1.53	-0.26602
Other services	0.05223	26.30	1.05	-0.32364

a/ From table 72, col. 3.

b/ (Col. 4) - ((col. 2) . (col. 3)).

c/ Local currency units.

Table 96. Computing adjusted intercept coefficients for expenditure functions of the extended linear expenditure system for urban areas using data for a selected year

Commodity group	Disposable income coefficient <u>a/</u>	Per capita disposable household income in year -2 (LCUs) <u>c/</u>	Per capita household consumption in year -2	Adjusted intercept coefficient <u>b/</u>
(1)	(2)	(3)	(4)	(5)
Food	0.41002	48.93	23.30	3.23772
Clothing	0.06637	48.93	3.71	0.46251
Housing	0.05144	48.93	1.42	-1.09695
Fuel and light	0.03972	48.93	3.31	1.36650
Durables	0.14387	48.93	3.63	-3.40955
Transportation	0.01193	48.93	0.64	5.62651
Personal care	0.02590	48.93	1.18	-0.08729
Recreation	0.06831	48.93	2.88	-0.46240
Other services	0.06105	48.93	1.97	-1.01717

a/ From table 77, col. 3.

b/ (Col. 4) - ((col. 2) . (col. 3)).

c/ Local currency units.

Table 97. Computing adjusted intercept coefficients for expenditure functions of the extended linear expenditure system for rural areas using data for a selected year

Commodity group	Disposable income coefficient <u>a/</u>	Per capita disposable household income in year -2 (LCUs) <u>a/</u>	Per capita household consumption in year -2	Adjusted intercept coefficient <u>b/</u>
(1)	(2)	(3)	(4)	(5)
Food	0.56330	23.73	12.45	-0.91710
Clothing	0.05910	23.73	1.60	0.19755
Housing	0.03527	23.73	0.82	-1.69571
Fuel and light	0.04354	23.73	1.84	0.80679
Durables	0.06922	23.73	0.99	-0.65259
Transportation	0.00766	23.73	0.30	0.11822
Personal care	0.03022	23.73	0.69	-2.71206
Recreation	0.03652	23.73	1.02	0.15338
Other services	0.02199	23.73	0.71	0.18817

a/ From table 78, col. 3.

b/ (Col. 4) - ((col. 2) . (col. 3)).

c/ Local currency units.

For example, the adjusted intercept coefficient in the urban expenditure function for food, 3.23772, is obtained as follows:

$$3.23772 = 23.30 - (0.41002) (48.93),$$

where 23.30 is the mean level of per capita household consumption of food in the urban areas in year -2; 0.41002 is the estimate of the urban disposable income coefficient for food; and 48.93 is the mean value of per capita disposable household income in the same location in year/-2.

C. Notation and equations

1. Indices, variables and special symbols

(a) List of indices

$g = 1, \dots, G$ are commodity groups
 t' is the given calendar year

(b) List of variables

$PCC(g, t')$ is the observed mean level of per capita household consumption in commodity group g in year t'

$PCDHI(t')$ is the observed mean level of per capita disposable household income in year t'

$PCTHE(t')$ is the observed mean level of per capita total household expenditure in year t'

(c) List of special symbols

$[a^*(g)]'$ is the adjusted intercept coefficient of the expenditure function for commodity group g in the linear expenditure system or in the extended linear expenditure system

$b^*(g)$ is the estimate of the partial coefficient of per capita total household expenditure in the expenditure function for commodity group g in the linear expenditure system, or the estimate of the partial coefficient of per capita disposable household income in the expenditure function for commodity group g in the extended linear expenditure system

G is the number of commodity groups

2. Equations

National Level

(i) Linear expenditure system

$$[a^*(g)]' = PCC(g,t') - b^*(g) \cdot PCTHE(t'); \quad (1)$$

$$g = 1, \dots, G$$

(ii) Extended linear expenditure system

$$[a^*(g)]' = PCC(g,t') - b^*(g) \cdot PCDHI(t'); \quad (2)$$

$$g = 1, \dots, G$$

Notes

a/ Depending on the demand system selected, the variable would be per capita total household expenditure or per capita disposable household income.

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