

Equivalence Scales

General Aspects





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by

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1 SUMMARY

This module illustrates how **inequality** and **poverty analysis** may be carried out when the income distribution is defined over households (i.e. household incomes) and not over individuals (i.e. individual incomes). When household incomes are considered, a problem arises with regard to the possibility of comparing *monetary* incomes of different households with different numbers of inhabitants. In this case, and as described in this module, a correction should be made to meaningfully compare different situations. This correction is called an **equivalence scale**. An equivalence scale may be a simple *per capita* measure or a more sophisticated way to take into account the fact that, within any given household, economies of scale may operate with regard to the consumption of certain goods. Applying an equivalence scale to monetary incomes of different households gives rise to an **equivalised income** that can be used for inequality, poverty or welfare analysis.

2 INTRODUCTION

Objectives

The aim of this module is to give the analyst the necessary tool to properly measure inequality and poverty and to carry out welfare analysis when the income distribution is defined over household incomes rather than on individual incomes.

This module is particularly important, as in the real world many income/consumption surveys give information on households rather than on individuals. Furthermore, public policies are often targeted to households. It is therefore vital to understand the way in which data on households may be used to measure the impact of such policies.

Target audience

This module targets all policy analysts who works in public administrations (central and local), NGOs, political parties, professional organizations or in consulting firms that are willing to enhance their expertise in analyzing inequality and poverty issues at household level. Lecturers in selected undergraduate courses in economics and related fields may also be interested in using this material for academic purposes.

Required background

This module complements all other EASYPol modules on inequality and poverty analysis and it is propaedeutic to them in any case in which the relevant income distribution to be analysed is defined on household incomes. It is therefore strongly recommended to go through the other EASYPol modules on inequality and poverty first.

The trainer is strongly recommended to verify how adequate the trainees' background is, notably their understanding of the concepts of "income distribution" and "social welfare". If their background is weak or missing, the trainer may consider delivering other related EASYPol modules beforehand. Other technicalities reported in this

module should be understood by all people with an elementary knowledge of basic mathematics and statistics.

A complete set links of other related EASYPol modules are included at the end of this module. However, users will also find links to related material throughout the text where relevant¹.

3 CONCEPTUAL BACKGROUND

3.1 General aspects

Income inequality and poverty have been analysed in other EASYPol modules simulating various income distributions based on **individual** incomes. However, there might be theoretical and practical reasons to work with income distributions where the unit of analysis is the **household**. From a theoretical point of view, household income is of great interest, as many decisions are taken within the household and because, to some extent, resources are shared among household members. This makes the household a natural reference point to understand the well-being of individuals. From a practical point of view, data often comes at household level. Therefore, we must have tools to manage this possibility.

The basic tool to prepare household data for a meaningful inequality and poverty analysis is the equivalence scale. The **equivalence scale** is an index converting nominal incomes of heterogeneous households in comparable measures of well-being. This index can be interpreted as the differential cost of having a given household size and composition with respect to a «benchmark» household type.

In other EASYPol modules where inequality and poverty are discussed, individuals have been assumed to be a natural reference point for measurement. The simplest case for the analyst, indeed, is to assume that «**individuals**» are the relevant unit. In this case, at a given point in time, **nominal** amounts of individuals' incomes or expenditures can be meaningfully interpreted as measures of well-being.² It would therefore be quite reasonable to say that an individual with income x has a higher level of welfare than an individual with income $y < x$.³

More generally, we say that nominal income is a good tool for measuring inequality when the population is **homogeneous**. A population is homogeneous if all households forming this population share the same relevant socio-demographic characteristics.

¹ EASYPol hyperlinks are shown in blue, as follows:

- a) training paths are shown in **underlined bold font**;
- b) other EASYPol modules or complementary EASYPol materials are in **bold underlined italics**;
- c) links to the glossary are in **bold**; and
- d) external links are in *italics*.

² In what follows the terms «income» and «expenditure» will be used interchangeably. In this context they are only representations of the household well-being.

³ Of course, it is implicit in this statement that individual welfare depends only on income.

Examples may be: single-person households; married couples without children; married couples with two children; two-person households where the head of the household is disabled; and so on.

In national surveys, data do not come very frequently at individual level and, where available, they are generally obtained by making assumptions on how total income is distributed among the various members (the issue of **intra-household** distribution of income). The reason is that, in many households, there are members (e.g. children) who consume resources but do not produce incomes. The individual income of these members would be zero, even though they share the household's total resources.

More common is the situation when data are collected at household level. But in this case households are generally **heterogeneous** because they differ both in size and composition. In the same population, we may have single-person households, married couples with a variable number of children, disabled, rural households, urban households and so on. In all these cases, nominal incomes are no longer a good indicator of well-being, because different households may have different needs **at the same level of total income**.

For example, has a two-parent household with three children and \$ 1000 the same level of well-being as a two-parent household without children and \$ 1000? If the answer is negative, even though the two households gain the same «nominal» income, the level of well-being will differ. Intuitively, we could think that the first household has more needs, because, unlike the second household, it has children.

What we are looking for, therefore, is a tool to convert nominal incomes into a «comparable» measure of well-being in all those cases where heterogeneous populations must be handled for inequality and poverty purposes. The problem is conceptually the same as when one has to compare two different amounts of money at **different points in time**. In this latter case, the standard procedure is to make the two amounts comparable in «real» terms using, for example, a price index in order to take into account the effects of inflation. In this case, in economic terms, nominal incomes (or incomes at current prices) are converted in real incomes (or incomes at constant prices). An analogous procedure applies when, at a given point in time, prices **differ in space** (e.g. rural vs. urban areas or among different countries). The standard procedure here is to use a purchasing power parity (PPP) price deflator to convert nominal incomes in comparable real amounts⁴.

In order to compare households of different size and composition, it is therefore natural to follow the same procedure, using an analogous kind of deflator. The appropriate deflator in this case is the **equivalence scale**.

Formally, the equivalence scale establishes a functional relationship between nominal incomes and incomes adjusted for the equivalence scale. Define this latter as «equivalent income». Therefore, denoting y as nominal income and y_e as equivalent

⁴ Prices may indeed differ in space, especially in the case of large countries or in those countries where the rural and urban areas show wider gaps of economic development.

income, the relation between nominal and equivalent incomes assumes the following general form:

$$[1] \quad y_e = \frac{y}{\lambda(\mathbf{d})}$$

where λ denotes the functional relationship depending on the vector of the relevant demographic characteristics \mathbf{d} . The vector of demographic characteristics may contain different variables. In applied work, it very often includes household size, but it might also include professional status of the head of households (farmer, blue collar, etc.), household location (rural or urban), health conditions (disabled), etc.

3.2 Theoretical foundations

A natural question to ask is: where does λ come from? In other words, is the concept of equivalence scale theoretically founded? The answer is, yes. The general concept of equivalence scale has foundations on consumer theory, in particular on the representation of individual preferences⁵. In order to understand this point, it is worth going through some standard consumer theory.

Consumers' preferences may be represented in three different ways:

- A DIRECT UTILITY FUNCTION, depending on consumption. Analytically: $U = U(\mathbf{q})$ where \mathbf{q} is the vector of goods consumed;
- An INDIRECT UTILITY FUNCTION, depending on prices and income. Analytically, $U = \psi(y, \mathbf{p})$, where y is income and \mathbf{p} is the price vector;
- A COST FUNCTION depending on utility and prices. Analytically, $y = c(u, \mathbf{p})$, where u is the level of utility.

Between the direct utility function and the cost function there is a relation of «DUALITY». The «standard» consumer's problem is indeed that of *maximising the utility level subject to a given budget constraint (or cost)*. The «dual» problem is that of *minimising the cost subject to a given utility level*. The vector of goods chosen, quite obviously, must be the same in both cases.

Between the *indirect utility function* and the *cost function* there is instead a relation of «INVERSION». Given a cost function we can always obtain an indirect utility function by solving the first for the level of utility.

The cost function, therefore, is a theoretically founded way to represent consumers' preferences. It depends on the price vector⁶ and utility. Since the cost function gives the

⁵ The standard reference for these issues is Deaton and Muellbauer, 1980.

⁶ To simplify, the price vector is here assumed the same for all households, but it might be that prices differ over space (e.g. rural and urban areas). This means that not all households would face the same prices; only subgroups of them will do. In this case, the cost of an additional child could be variable in different areas.

minimum cost of achieving a given level of utility, we can use the cost function to calculate what is the additional cost for a household of a given size and composition to achieve the same level of utility of a benchmark household. To make this step, it is therefore necessary to extend the cost function to include the vector of socio-demographic characteristics \mathbf{d} :

$$[2] \quad C(\mathbf{p}, u, \mathbf{d})$$

Therefore, the equivalence scale λ is defined as:

$$[3] \quad \lambda = \frac{C(\mathbf{p}, u, \mathbf{d}_k)}{C(\mathbf{p}, u, \mathbf{d}_0)}$$

i.e. as the ratio between the minimum cost to achieve utility for the household with demographic characteristics \mathbf{d}_k and the minimum cost of achieving the same level of utility for the benchmark household with characteristics \mathbf{d}_0 . Recalling our previous example, if \mathbf{d}_k is «three children» and the benchmark \mathbf{d}_0 is «no children», the equivalence scale measures the differential cost of having three children with respect to the benchmark (no children).

In this general form, the equivalence scale is therefore a CONSTANT-UTILITY, CONSTANT-PRICE, COST-OF-LIVING INDEX relating the cost of living at household characteristics \mathbf{d}_k to that for some reference household with characteristics \mathbf{d}_0 .⁷

Apart from this theoretical foundation, equivalence scales are calculated in many different ways. These issues are dealt with in other modules⁸.

4 SOME NUMERICAL EXAMPLES FOR EQUIVALENCE SCALES

At this stage, some simple examples may help to understand what an equivalence scale does. Recall our two-parent household with three children and the two-parent household without children, both with \$ 1000. Assume this latter household as the «**benchmark household**», i.e. the household type against which we will measure the differential cost of having different household sizes. For the benchmark household, the equivalence scale is $\lambda=1$, i.e. equivalent income is equal to nominal income. Now assume that the calculated equivalence scale for the household with three children is $\lambda=1.6$. The application of formula [1] would give the result in Table 1, below:

⁷ Deaton and Muellbauer, 1980, p. 205.

⁸ EASYPol Modules 033 and 034 respectively: [Equivalence Scales: Subjective Methods](#) and [Equivalence Scales: Objective Methods](#).

Table 1 - Equivalence scales: example 1

Household type	Nominal income	Equivalence scale	Equivalent income
Two-person household with three children	1000	1.6	625
Two-person household without children	1000	1	1000

The last column of Table 1 reveals that, in equivalent terms, the first household is worse off than the second household, even though both have the same nominal income. In particular, the first household has a «real income» of 625 currency units compared with the second household who has a real income of 1000 currency units. The hypothesised equivalence scale λ also reveals that to have the same level of well-being, the first household should have sixty per cent more nominal income. Table 2, below, illustrates this case.

Table 2 - Equivalence scales: example 2

Household type	Nominal income	Equivalence scale	Equivalent income
Two-person household with three children	1600	1.6	1000
Two-person household without children	1000	1	1000

In this case, two rather different nominal incomes give rise to the same level of well-being (1000 currency units).

As already noted above, the equivalence scale is commonly used to take into account differences in family size. However, it can also be used to estimate the differential cost of other socio-demographic characteristics. For example, has a two-person household with \$ 1000 the same level of well-being as a two-person household with \$ 1000 where the head of the household is disabled? Common sense would suggest that the second household is more needy. If it is true, again, nominal incomes are not a good indicator of well-being. If the cost of being disabled is estimated against the benchmark case of households without disabled members and the equivalence scale is, say, 1.2, 1000 currency units for the second household would worth only about 833 currency units (1000:1.2) in equivalent terms (Table 3).

Table 3 - Equivalence scales: example 3

Household type	Nominal income	Equivalence scale	Equivalent income
Two-person household without children	1000	1.2	833
Two-person household without children and head disabled	1000	1	1000

5 CONCLUSIONS

This module has discussed the introductory concepts to analyse the issue of equivalence scales. Equivalence scales may be seen as a deflator converting nominal income in proper measures of well-being in order to make households with different size and composition comparable in inequality and policy analyses.

6 READERS' NOTES

6.1 Time requirements

The delivery of this module to an audience already familiar with the concept of income distribution, may take about two hours.

6.2 Frequently asked questions

- ✓ **What is an equivalence scale and what aim does it serve?** An equivalence scale is a tool that allows us to make possible meaningful comparisons between households of different sizes and composition.
- ✓ **Does the equivalence scale follow the same logic of a price deflator or purchasing power parity index?** Yes, but while the price deflator and the purchasing power parity are mainly descriptive tools, equivalence scales have a more precise theoretical foundation, based on the utility theory.
- ✓ **How do I convert nominal incomes in equivalent incomes?** An appropriate equivalence scale must be chosen. This is the object of the modules on subjective and objective poverty⁹.

⁹ See EASYPol Modules 033 and 034 respectively [see footnote 10 above for links].

6.3 References and further readings

Useful readings on this topic are the following:

- Buhmann B., L. Rainwater, G. Schmaus, T. M. Smeeding, 1988. Equivalence Scales, Well-being, Inequality and Poverty, *Review of Income and Wealth*, **34**.
- Coulter F., F. Cowell, S. Jenkins, 1992. Equivalence Scale Relativities and the Extent of Inequality and Poverty, *Economic Journal*, **102**, pp.1067-1082.
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- Deaton A., Muellbauer, 1986. On Measuring Child Costs: With Application to Poor Countries, *Journal of Political Economy*, **94**, pp. 720-744.
- Deaton A., 1997. *The Analysis of Household Surveys*, The Johns Hopkins University Press, Baltimore and London, USA.
- Nelson J., 1993. Household Equivalence Scales: Theory versus Policy?, *Journal of Labour Economics*, **11**, pp. 471-493.
- Pollak R. A., T. Wales, 1979. Welfare Comparisons and Equivalence Scales, *American Economic Review*, **69**, pp. 216-221.

Module metadata

1. EASYPol module 032

2. Title in original language

English	Equivalence Scales
French	Échelles d'équivalence
Spanish	
Other language	

3. Subtitle in original language

English	General Aspects
French	Généralités
Spanish	
Other language	

4. Summary

This module illustrates how inequality and poverty analysis may be carried out when the income distribution is defined over households (i.e. household incomes) and not over individual (i.e. individual incomes). When household incomes are considered, a problem arises with regard to the possibility of comparing *monetary* incomes of different households with a different number of members. In this case, as described in this module, a correction should be made to meaningfully compare these situations. This correction is called an equivalence scale. An equivalence scale may be a simple per capita measure or a more sophisticated way to take into account the fact that, within any given households, economies of scale may operate with regard to the consumption of certain goods. Applying an equivalence scale to monetary incomes of different households gives rise to an equivalised income that can be used for inequality, poverty or welfare analysis.

5. Date

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7. Module type

- Thematic overview
- Conceptual and technical materials
- Analytical tools
- Applied materials
- Complementary resources

8. Topic covered by the module

- Agriculture in the macroeconomic context
- Agricultural and sub-sectoral policies
- Agro-industry and food chain policies
- Environment and sustainability
- Institutional and organizational development
- Investment planning and policies
- Poverty and food security
- Regional integration and international trade
- Rural Development

9. Subtopics covered by the module

10. Training path

Analysis and monitoring of socio-economic impacts of policies

11. Keywords