Equivalence Scales

Subjective Methods

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by

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1   SUMMARY

This module illustrates how to use subjective methods to derive **equivalence scales**. Different methods exist, but the focus will be on parametric methods. These methods are based on the definition of two broad sets of parameters. The first defines the degree of economies of scale within any given household; the second defines how much any further member adds to the cost of running a family. As we will see, the two concepts are linked, giving rise to a variety of ways to parameterise equivalence scales.

2   INTRODUCTION

Objectives

The aim of this module is to give the analyst the necessary tool to properly derive equivalence scale on the basis of a subjective assessment[1].

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

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 EASYPol Modules beforehand, as highlighted in the introduction. Other technicalities present 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 relevant[2].

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[1] This module is a further step in studying equivalence scales and it is strongly recommended that it should not be delivered before the EASYPol Module 032: ***Equivalence Scales: General Aspects***.

[2] 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*.

3   CONCEPTUAL BACKGROUND

The issue of how to estimate equivalence scales is an old issue and methodologies can be split into two broad categories:

- Subjective methods
- Objective methods

The first category includes all those methods of building equivalence scales on the basis of «subjective» information on the appropriate weights to assign to different household members. In particular, it includes: **a**) parametric methods; **b**) questionnaire methods; **c**) nutrition or subsistence income-based approaches. This module will deal with these options.

The second category, instead, encompasses all methods based on observed behaviour and, in more sophisticated versions, econometric techniques. Within this latter class, we can further distinguish among: **a**) appropriate proxy variables for household welfare; **b**) utility-based methods[3].

Figure 1 illustrates the available paths to derive equivalence scales.

Figure 1 - Methods of deriving equivalence scales
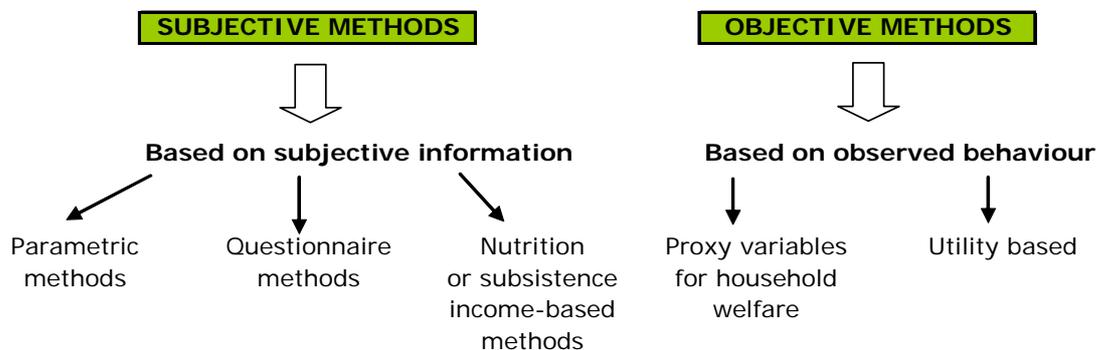
3.1   Subjective methods – Parametric equivalence scales

Parametric methods of estimating equivalence scales are the shortest way for an analyst to achieve the result of comparing households of different sizes and composition. The main characteristic of **Parametric Equivalence Scales (PES)** is that they are based on «discretionary» choices. By «discretionary» we mean that PES do not need to be theoretically founded, rather their value may be the result of subjective judgement of the analyst. Nevertheless, discretionary does not mean «arbitrary» as the analyst should use all the available external information to set meaningful values to the equivalence scale.

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[3] These options will be discussed in EASYPol Module 034: _**Equivalence Scales: Objective Methods**_.

The most popular PES, which only takes into account family size N, has the following parametric form:

[1] $$\lambda_1 = N^\sigma$$

which links equivalent and nominal income in the following way:[4]

[2] $$y_e = \frac{y}{N^\sigma}$$

where $0 \leq \sigma \leq 1$ is a «SCALE RELATIVITY PARAMETER»[5] measuring the intensity of economies of scale in consumption.

The basic functioning of λ_1 can be appreciated by discussing the possible values of σ.

If $\sigma=1$, equivalent income is simply «per capita income», as nominal income would be divided by household size N. In this case, the analyst is assuming that any additional household member would need as many resources as any other member for the household to be at the same level of well-being. This would mean that if a single person gets married, the new household will need twice as much income as the single individual to stay at the same level of well-being. This particular assumption may be debatable. Within the same household there are goods that are, in some sense, «PUBLIC», i.e. they can be consumed by more individuals at the same time. Technically, they are «NOT RIVAL» in consumption. Two people do not need two houses, and probably they do not need two televisions or two radios or two washing-machines, or two kitchens, nor do they need two copies of the same book, etc. Furthermore, within the household, there may be goods that, even if not "public", can be used by various members at different times. If a household has one child and then another one arrives, most clothing and toys dismissed by the first child may be used for the second. Both considerations lead to the possibility that households may enjoy a certain degree of «ECONOMIES OF SCALE IN CONSUMPTION». When $\sigma=1$ is chosen, these economies of scales are ruled out. In this case, per capita income is the proper indicator of well-being. This is an extreme assumption.

If $\sigma=0$, equivalent income is simply equal to total household income, as $N^0=1$. This is another extreme assumption. In this particular case, economies of scale are at their maximum, as $\sigma=0$ means that an additional member does not need additional resources to leave the household at the same level of well-being. It implies that we assume that all goods are «public» within the household. This is obviously not true, because there are

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[4] This characterisation of the equivalence scales is due to Buhmann *et al*., 1988, that demonstrate that it provides for a good approximation to many different scales used in empirical applications. This scale is used by numerous studies, especially for developed countries. An extensive use of it in inequality comparisons in OECD countries is in Atkinson *et al*., 1995.

[5] This definition is by Coulter *et al*. ,1992.

typically «PRIVATE» goods in a given family (e.g. food), i.e. goods that are «RIVAL» in consumption.

If $0<\sigma<1$, economies of scale are not at their maximum but they are admitted up to a certain degree. Higher σ will indicate less economies of scale (as $\sigma=1$ means no economies of scale). From an empirical point of view, it is good practice to test the results comparing different values of σ. In applied works, generally σ is set between 0.65 and 0.75.

The main characteristics of λ_1 are:

- For a given σ, equivalent income decreases as household size increases;
- For $N>1$, equivalent income decreases as σ increases.

The weight of each household member is the same, as σ is applied to the household size N. In other words, it is assumed that any additional member counts the same with respect to income needs. To illustrate this point, suppose, for example, that we use λ_1 to equivalise food expenditures (instead of total income). Food, within the household, can be assumed to be a «private» good. Therefore, σ should be set to 1. In this case, [5.6] would give *per capita* food expenditures as the proper indicator of well-being. However, it may well be the case that children need less food (or more food) than adults and that adult males need more food than adult females. Therefore, even in the absence of economies of scale, per capita expenditures might not be the best indicator of well-being if the needs of various household members vary. λ_1 does not take into account this latter type of relativity, it just sets an overall parameter of economies of scale, which summarises the empirical observation that within the same family some goods are private and some goods are public.

Two types of relativities thus emerge:

- the need of additional members with respect to the first adult (relativity I);
- the degree of economies of scale (relativity II).

To take into account both at the same time, λ_1 can be extended as follows:

[3] $$\lambda_2 = \left(a + \theta c\right)^{\sigma}$$

where a is the number of adults, c is the number of children and $\theta \leq 1$ is the relative need of children with respect to adults. For example, it is set that a child needs 50 per cent as much resources as an adult, $\theta=0.5$. In this way, the term in round brackets in [6] would provide information not on the total household size but on the number of «EQUIVALENT ADULTS». Recalling our example on food expenditures, with $\sigma=1$ (no economies of scale), the application of λ_2 would now give «equivalent» food expenditures (not *per capita*) as the proper measure of well-being. More generally, when total expenditures (or income) are considered, θ would indicate that, on average, children need less

resources than adults, while σ would indicate the intensity of consumption sharing among household members.

The different role and meaning of relativity I and relativity II can be further appreciated by noting that when σ=0 (full economies of scale), λ_2=1, whatever the value assigned to θ. This means that, when full economies of scale prevail, defining differential needs is meaningless, as all members consume the same amount of goods.

A further extension of [6] differentiates not only between children and adults but also between the first adult and any additional adult. Formally:

[4] $$\lambda_3 = \left(1 + \delta(a-1) + \theta c\right)^\sigma$$

where symbols have the usual meaning. In this case, δ≤1 gives information on the relative need of additional adults with respect to the first. For example, it might be the case that the needs of an adult female be lower that those of an adult male.

A very popular special case of [4] is the **OECD scale**. The OECD scale can be obtained by setting: σ=1; δ=0.7; θ=0.5. A modified version of the OECD scale sets δ=0.5 and θ=0.3. Based on our previous discussion, the OECD scale does not allow an explicit role for economies of scale, rather it measures the relative needs of household members with respect to the first adult.[6] Therefore, if the OECD scale were used to equivalise food expenditures or heating expenditures within a given household, it could not fully take into account that food is a «private» good, while heating is a «public» good, for which, as already observed, the specification of differential needs has less meaning.

At this stage, it should be clear that if all goods were purely «private» there would not be economies of scale in consumption; in this case the equivalence scale should reflect only the differential needs of the various household members with respect to those goods. If all goods were purely «public», there would not be any differential need among household members. For example, if heating is supposed to be a pure public good within the household, it does not make sense to say that a child needs 1.5 as much heating as the first adult.

The formal representation in [4] clearly reveals this feature. When σ=0 (full economies of scale) equivalent expenditure is equal to total expenditures whatever the coefficients assigned to additional adults and children. Assigning these coefficients therefore makes sense only if goods are purely private or not purely public within the household, i.e. when σ>0.

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[6] It may be the case, however, that the values of the coefficients are set by embodying in them the existence of economies of scale in consumption. With this hypothesis, the OECD scale would not distinguish between economies of scale and household members relative needs.

3.2   Subjective   methods: Individual   responses   to   questionnaires

Equivalence scales may be constructed on the basis of direct interviews on what it is considered, by a given individual, to be the proper cost of expanding his/her family size. This approach could be implemented by asking for example «by how much should your income increase to be at least as well off as in the present status, if you add a child to your household?». The answer, which is generally given in monetary terms, would reflect the additional cost of having that particular demographic event. The advantage of this approach is to generate direct information, that the analyst can use in constructing equivalence scales, depending on the *specific social and economic context*. Parametric equivalence scales above analysed lacks in this link with the specific context, as these latter scales are often applied in very different contexts. There, either relative needs or economies of scale, may be very different from the original reasons motivating the choice of coefficients and the scale relativity parameter[7].

This advantage, however, is balanced by at least three shortcomings:

- The first is that the equivalence scale is based on what people *believe* what is the minimum cost to achieve a given level of well-being after including either an additional adult or child to the household. Different answers might not be comparable if households have different perceptions of well-being. A better alternative might be that of specifying economic conditions by, say, «bad», «good», «very good», even though different households may also have different perceptions of these[8].

- The second is that the answer (and therefore the equivalence scale) may depend on the position of the individual in the income distribution. Richer people tend to overstate the «true» cost, while poor people are likely to reveal a smaller cost. In this sense, unlike PES, equivalence scales inferred from questionnaires are not independent of level of income. This may or may not be a desirable feature, but it is something to take into account when using interviews.

- Thirdly, to represent the specific social and economic context, questionnaires must be designed with appropriate sampling procedures that are just as sophisticated as those used for either national or farm surveys. This procedure may encounter many problems and it may be very time consuming if the aim is only to estimate equivalence scales.

For these reasons, estimation by questionnaires does not generally gain much consensus. Empirical studies using this approach are not very many.

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[7] In applied works, for example, OECD scale is often applied to both developed and developing countries, yet relative needs and economies of scale might be very different in the two cases.

[8] Questionnaire have been used by Danziger *et al*., 1984. A case where the set of economic conditions has been specified is van Praag *et al*., 1982.

3.3   Subjective methods – Income-based methods

Equivalence scales may also be calculated using information on the cost of the minimum consumption basket for both adults and children. This method is basically organised along the following lines:

- Determining the nutritional requirement of each household member. This may also be a food security standard.
- Converting nutritional requirements or food security levels into monetary levels.
- Comparing monetary levels among households of different sizes and/or composition to infer the additional cost of socio-demographic characteristics, i.e. the equivalence scale.

This method of calculating equivalence scales shares the same advantage of the questionnaire methods, i.e. that of being based on the specific social and economic context where equivalence scales will be applied. The most important shortcomings are:

- There might be a mismatch between the estimated nutritional requirements and the actual consumption of food because of, say, different tastes on the composition of the commodity basket.
- Equivalence scales based on nutritional requirements rule out economies of scale by definition, as they only take into account nutritional differences among household members with respect to good (food) which is «private» within the household.
- As this method of calculating the equivalence scale is based on the determination of «subsistence» levels, there is no guarantee that the same scale would prevail at higher levels of well-being.

By saying that to feed a child his/her minimum nutritional requirements takes 40 per cent of the amount it needs to feed an adult, does not say anything about the relative needs for other commodities. Using these scales to convert total expenditures into equivalent expenditures may therefore leave out of the analysis important information.

As in the case of questionnaire methods, empirical studies using nutritional requirements are not very many.

4   A STEP-BY-STEP PROCEDURE TO BUILD EQUIVALENCE SCALES BY SUBJECTIVE METHODS

4.1   A step-by-step procedure for parametric equivalence scales

Figure 2, below, illustrates a step-by-step procedure to calculate the parametric equivalence scale. **Step 1** requires that we define the relative need of some demographic characteristics with respect to a given benchmark (relativity I). For example, we may be required to define the relative need of children with respect to adults. **Step 2** requires

that we define the presence of the scale relativity parameter, measuring the intensity of economies of scale in consumption (relativity II). Once these two elements have been set, **Step 3** requires that we combine them in a functional form, like equations [4], [6] or [7] in the text. It is worth recalling that in the simplest form, the equivalence scale does not need to embody both elements (relativity I and relativity II).

Figure 2 - A step-by-step procedure to build parametric equivalence scales

STEP	Operational content
1	Define the need of additional members with respect to the first adult (relativity I)
2	Define the degree of economies of scale in consumption (relativity II)
3	Choose a functional form to combine Step 1 and Step 2 as in equations [1], [3] or [4] in the text

4.2   A step-by-step procedure for equivalence scales from questionnaire

This procedure is very simple, as we only have to take information of the additional burden caused by additional household members directly from them. The most difficult task of this direct method, therefore, is not to calculate the equivalence scale, but to correctly implement a set of interviews to get meaningful answers on additional economic costs. Therefore, there is no specific step-by-step procedure, as the equivalence scale is taken to be the subjective revealed evaluation of the cost by interviewees.

4.3   A step-by-step procedure for income-based methods

Figure 3, below, illustrates the basic procedure to calculate income-based equivalence scales. In this case, the starting point is represented by the definition of a nutritional requirement for each household member (**Step 1**). Different members may have different requirements. In order to make them comparable, it is necessary to convert these requirements into monetary levels, e.g. by pricing the goods belonging to the nutritional requirement (**Step 2**). The procedure is analogous to that used for pricing absolute poverty lines based on food requirements[9]. Monetary levels are then fully

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[9] See EASYPol Module 004: ***Impacts of Policies on Poverty: The Definition of Poverty***.

comparable. The difference between these levels among households of different size/composition gives an estimation of the equivalence scale (**Step 3**).

Figure 3 - A step-by-step procedure for income-based equivalence scales

STEP	Operational content
1	Define a nutritional requirement for each household member
2	Convert nutritional requirements into monetary levels
3	Compare these monetary levels among different households. The difference gives the additional cost of the relevant socio-demographic characteristic
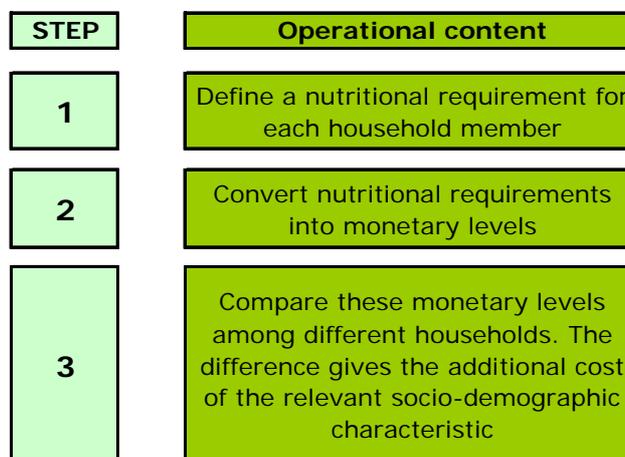
5   NUMERICAL EXAMPLES FOR EQUIVALENCE SCALES

5.1   An example for parametric equivalence scales

Table 1, below, reports an example of how to calculate a parametric equivalence scale. The example is built by considering a household with two spouses and three children. **Step 1** defines the relative need of both the second adult and of each child with regard to the first adult. Given a coefficient of 1 for the first adult, it is assumed that the second adult is worth 0.7, while each child is worth 0.5.

Table 1 - An example for parametric equivalence scales

STEP 1		STEP 2		STEP 3
Define the need of the second adult and of three children with respect to the first adult		Define the degree of economies of scale in consumption		Define equivalence scale (e.g. using [7])
Coefficients for two adults:		Coefficient:		Equivalence scale:
- first adult	1	s	0.5	1.789
- second adult d	0.7			
Coefficients for adults: (q)				
- first child	0.5			
- second child	0.5			
- third child	0.5			

Step 2, instead, requires that we define the degree of economies of scale in consumption, which is assumed to be 0.5. **Step 3** calculates the equivalence scale according to formula [7] in the text, giving a result of 1.789. How do we interpret this number? This number is the deflator to apply to the nominal income of the household in

order to assure comparability with a single-person household. For example, suppose that the nominal income of a single-person household is 1000 currency units and that the same nominal income is gained by a household with two adults and three children. In the above example, the single-person household is the benchmark. Therefore, its nominal income of 1000 currency units is also its real income. In the case of the household with children, the nominal income of 1000 must be deflated by the equivalence scale in order to have a comparable real income (1000/1.789). This operation gives rise to a value of about 559. This means that, in terms of well-being, the single-person household is about twice as much better off than the household with two adults and three children, even though their nominal income is the same.

It is worth considering that the distance between equivalised incomes may change if the coefficients are changed. This is typical of a subjective parametric equivalence scales. Therefore, they must be handled with caution in applied works. It is good practice to apply different parametric equivalence scales in order to test whether results change significantly.

5.2   An example for income based methods

Table 2, below, reports the example for an income-based equivalence scale. **Step 1** requires first to calculate the nutritional requirement for each household member. In our example, this is simply assumed to be 1,500 kcalories for adults and 1,800 kcalories for children. **Step 2** converts these nutritional requirements into monetary values. The procedure is not explicit in the example, but the most common way may be to price the basket of goods forming the nutritional requirement.

Table 2 - An example for income-based equivalence scales

STEP 1		STEP 2		STEP 3		STEP 3	
Define the nutritional requirement for each household member (e.g. in terms of calories)		Convert nutritional requirements into monetary levels		Consider a household with two adults and no child		Consider a household with two adults and one child	
Nutritional requirement for adults (kc	###	Each adult	####	Total number of adults	2	Total number of adults	2
Nutritional requirement for children (	###	Each children	####	Total number of childr	0	Total number of childr	1
				Value:	20,000	Value:	####
						Equivalence scale	1.60

For the sole purpose of working out the example, each adult has a monetary value of 10,000 currency units and each child has a monetary value of 12,000 currency units. Now, in **Step 3**, consider two households: the first with two adults and no children, the second with two adults and one child. The monetary value corresponding to the nutritional requirement of the first household is equal to 20,000 (10,000 times two adults). The same value corresponding to the nutritional requirement of the second household is equal to 32,000 (10,000 times two adults plus 12,000 times one child). Taking the ratio between the two (32,000/20,000) gives 1.6. This means that an additional child needs 60 per cent more income than the no-child case. Therefore, if the two households had the same nominal income of 50,000 currency units, in terms of well-being, the household with one child would be worse off with an equivalised income of 31,250 (50,000/1.6).

6   CONCLUSIONS

This module llustrates how to perform a calculation of subjective equivalence scales. In particular, it has focused on parametric equivalence scales, distinguishing two types of relativities. The first is the need of additional members in a household; the second is concerned with the degrees of economies of scale in consumption. This module gives the analyst the possibility to properly perform either an inequality or poverty analysis when the relevant unit of analysis is the household and not the individual.

7   READERS′ NOTES

7.1   Time requirements

The delivery of this module to an audience already familiar with the concept of income distribution and with the general issues of equivalence scales may take about two hours.

7.2   Frequently asked questions

✓ **What are parametric equivalence scales?** A parametric equivalence scale is an equivalence scale in which the analyst makes a choice on the amount of needs required by additional members or on the proper degree of economies of scale in consumption.

✓ **If I change parameters do I also change the value of equivalence scales?** This is a shortcoming of the approach. Changing parameters of the equivalence scale changes the equivalence scale itself. In turn, it may change inequality and poverty outcomes. It is strongly recommended, in empirical works, to perform the analysis with different equivalence scales or with methods that are robust to the choice of equivalence scale.

7.3   Complementary capacity building materials

EASYPol Module 032: *Equivalence Scales: General Aspects* is strongly recommended.

8   REFERENCES AND FURTHER READINGS

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Module metadata

1. EASYPol Module	033

2. Title in original language	
English	Equivalence Scales
French	
Spanish	
Other language	

3. Subtitle in original language	
English	Subjective Methods
French	
Spanish	
Other language	

4. Summary

This module illustrates how to use subjective methods to derive equivalence scales. Different methods exists, but the focus will be on parametric methods. These methods are based on the definition of two broad sets of parameters. The first defines the degree of economies of scale within any given households; the second defines how much any further member adds to the cost of running a family. As we will see, the two concepts are linked, giving rise to a variety of ways to parameterise equivalence scales.

5. Date

November 2005

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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	